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NOTICES :—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Filtration in Modern Industry

THERE is scarcely any practical process with wider industrial and scientific applications than that known as filtration. Crude and simple in its original forms, it goes back to very early times, because its need for domestic purposes was so obvious even to primitive mankind. Step by step it has developed into a highly scientific operation, and from about the middle of the last century enormous advances have been made in the knowledge of its principles, in its new applications to industry and the needs of the community, and in the great variety of mechanical apparatus, from the simple laboratory filter paper to expensive plant installations, that is now available for practically every type of filtration.

The literature of this important subject has been definitely enriched by the publication of Mr. J. A. Pickard's monumental work on "Filtration and Filters" (Ernest Benn, pp. 488, 45s.), of which some notice is given in this issue. It is an authoritative work that no student of the science can afford to miss. In addition to the author's very thorough investigation of the subject, Mr. A. J. V. Underwood discusses the mathematics of filtration and Dr. Prausnitz supplies a compact account of glass filter apparatus.

In filtration, as in so many other directions, the empirical or rule-of-thumb stage is now a thing of the past. For processes so varied and delicate, there must be a sound basis of scientific knowledge, which the specialist in the design and construction of filtration plant must have fully mastered. This aspect of the subject is taken full account of in Mr. Pickard's new volume. But the science of the subject is, after all, but one side ; that is the province of the professor, the chemical engineer, and the plant manufacturer. The industrialist applies a more direct test, the test of practical results. The public authority that desires its water supply to be pure ; the architect who wants a supply of pure air for his building ; the works that must have its gases filtered and its effluents purified ; the public that wants its seaboard kept free from oil pollution ; the private company that requires filtration for its sugar or the public body that equally needs it for its sewage—all these know what they want in the way of guarantees of purity and look to the filtration industry to supply them.

It may fairly be claimed that the industry is prepared for the test. An immense variety of systems and apparatus is available for selection. Of these some idea is given in Mr. Pickard's work. He has collected 450 illustrations, constituting a virtually complete representation of the best modern practice, from the productions of nearly a hundred well-known firms in Great Britain, France, Germany and the United States. This, it is true, is not entirely exhaustive, but it has a good claim to be representative, and will be of permanent value to the industry and its clients.

Wide as the range of filtration processes already is, their application is far from being limited to their present uses. In existing fields the standards of efficiency are constantly being raised, and new industries are steadily being developed. The function of the filtration industry, therefore, is not merely to cater for existing requirements. It will be equally serving itself and the community by educating the public up to a higher level and introducing its operations to new fields.

A Wood Preserving Association

AN important proposal for the formation of a Wood Preserving Association is, we understand, to be considered at a meeting at the Metropole Hotel, Northumberland Avenue, London, on Tuesday next, December 3, at 3 p.m., at the invitation of Sir Harold Boulton and Sir James Calder. The Association has as its chief object the prevention of wastage of wood caused by neglect to use proper means of preservation against rot and the attacks of insects, and for the prosecution of this work chemical research is of vital importance.

Although it has been customary for many years in the United Kingdom to use protectively treated wood for railway sleepers, telegraph poles, piles and fencing posts, those who are interested in the formation of the Association feel that this practice should be extended to wood used for many other purposes, such as buildings, wooden structures, wagons, etc., not only in the United Kingdom but throughout the world, in order to preserve timber resources, especially those of the British Empire.

It is proposed that the Association should examine the causes of destruction or deterioration of wood and investigate all the processes or methods used or suggested for its protection. In the United Kingdom, the activities of the Association will be particularly directed towards the prevention of waste of home grown timber in order that home forestry may be assisted. The Association hopes to co-ordinate practical and commercial research in all parts, in which task it will receive the co-operation of H.M. Forest Products Research Laboratory at Princes Risborough. It will also give close attention to the matter of specifications for wood preservatives and adherence thereto.

Lord Clinton, accompanied by other Forestry Commissioners, will attend the meeting, and the Post Office and the four railway groups will be represented. Representatives will also attend from the principal timber preserving interests in the country, from many timber firms, from the Timber Trade Federation, from many estate owners, and from among those interested in forestry or in the manufacture of timber preserving preparations. It is hoped that anyone interested in wood preservation who may not have hitherto received notification of the scheme to form a Wood Preserving Association will at once apply to Sir Harold Boulton, Association of Tar Distillers, 166, Piccadilly, W.1 (Regent 2268), for an invitation to the meeting on December 3.

Chemical Engineering Progress

THE chemical engineers, in their methodical and business-like way, continue to make excellent progress, both through the Institution and through the Group, which admirably supplement each other's work. What promises to be one of the most important conferences organised by the Institution is that fixed for next Thursday and Friday in the rooms of the Chemical Society, Burlington House, London. The subject chosen is "Vapour absorption and adsorption." With the continual growth of competition, the recovery of important materials which would otherwise be wasted becomes a matter of grave concern for all industrial organisations. Apart from the commercial aspects of the matter, the discharge of effluents, both liquid and gaseous, may become, unless efficiently treated, a menace to the health of both of those engaged in the industries concerned and of the community at large. Some of these problems—of immediate interest to the public in certain relations—may be expected to be discussed with knowledge and experience at next week's conference.

The chairmen at the four sessions will be the President (Mr. Arthur J. Reavell), Mr. F. H. Rogers (vice-president) Mr. W. Macnab (a past vice-president) and Mr. C. S. Garland (vice-president). The papers, as will be seen from the following list, cover a wide and interesting field, namely, "The reversibility of the adsorption process and the thickness of the adsorption layer," by Professor J. C. Philip, F.R.S.; "The recovery of acetone vapours from the air," by Dr. W. R. Ormandy; "The recovery of benzol from coal gas, with special reference to the use of activated carbon," by Mr. H. Hollings, M.Sc., A.I.C., S. Pexton, Ph.D., and R. Chaplin, Ph.D.; "The absorption of nitrous gases," by Harry W. Webb, M.Sc., F.I.C.; "The recovery of volatile solvents (Brégeat process)," by A. Hoch; "The continuous fractionation of gases by adsorbents," by J. Stanley Morgan; "Evaporation of water in open pans," by G. W. Himus, B.Sc., A.R.C.S., etc.; and "The industrial application of active carbon," by K. Evans, A.R.C.S., A.I.C., and H. F. Pearson. We are authorised to say that all interested in these questions are welcome to attend and to participate in the discussion, and that full particulars of the conference may be obtained from the hon. secretary of the Institution, Abbey House, Westminster, London, S.W.1.

The Calendar

Dec.		
2	University of Birmingham Chemical Society: "Some Recent Researches in Co-ordination Compounds." Dr. W. Wardlaw.	University, Birmingham.
2	Society of Chemical Industry (London Section): "The Formation of the Photographic Image." Dr. Walter Clark. "Chemistry and Certain Problems of Applied Mycology." H. Martin. 8 p.m.	Burlington House, Piccadilly, London.
4	Institute of Metals (Swansea Section): "Coke Carbonisation and By-Products." G. Crift. 7 p.m.	Thomas's Café, High Street, Swansea.
4	Society of Public Analysts. 8 p.m.	Burlington House, London.
5	Society of Chemical Industry and Institute of Chemistry (Yorkshire): Chemists' Dinner. 7.30 p.m.	Great Northern Hotel, Leeds.
5	Institution of the Rubber Industry (Scottish Section): "The Use of Rubber as a Lining for Chemical Plant and Methods of Application."	Caledonian Hotel, Edinburgh.
5	Chemical Society. 8 p.m.	Burlington House, Piccadilly, London.
5	Society of Chemical Industry (Birmingham and Midland Section): "Petroleum Hydrocarbons as Chemical Raw Materials." H. M. Stanley. 6.30 p.m.	Chamber of Commerce, New Street, Birmingham.
5, 6	Institution of Chemical Engineers. Conference on "Vapour Absorption and Adsorption." 10.30 a.m.	Burlington House, London.
6	Society of Chemical Industry (Liverpool Section): "The Manufacture of Tobacco." J. P. Davidson. 6 p.m.	University, Liverpool.
6	Institution of the Rubber Industry and Society of Chemical Industry (Manchester Sections): "Works Control in the Rubber Industry." H. C. Young.	Engineers' Club, Albert Square, Manchester.
6	National Smoke Abatement Society: "The Abatement of Industrial Smoke." R. Morton Rowe.	College of Technology, Manchester.
9	Institute of Metals (Scottish Section): "Melting Furnaces." G. L. Cassidy. 7.30 p.m.	39, ElmbankCrescent, Glasgow.
10	Institution of Petroleum Technologists. 5.30 p.m.	House of the Royal Society of Arts, Adelphi, London.
10	Institute of Metals (N.E. Coast Section): "Nickel in Non-Ferrous Foundry Alloys." W. T. Griffiths. 7.30 p.m.	Armstrong College, Newcastle-on-Tyne

The Science and Practice of Filtration

Its Part in Modern Industry

In the following pages some account is given of the general scope and principles of filtration as applied to modern industries, together with notes on typical filtration plant and apparatus.

ALTHOUGH the process of filtration, in crude and simple forms, goes back to very early times, its development into one of the most important and general operations in industry and the public health services is a comparatively modern growth. It enters in a greater or less degree into almost every manufacture, and the quality of many modern products depends very largely on the care and efficiency with which the operation is carried out. To begin with, perhaps, the commonest human need, we have the filtration of water for domestic and industrial needs; there are the delicate and exact filtration processes employed in the vital operations of the laboratory, and beyond these an immense field, including the filtration of air and gases, of lubricating, fuel, animal and vegetable oils, the separation of oil and water, the filtration of sugar, beer and wine, varnishes and paints, and the filtrative treatment of sewage. As the process has extended into new fields, so the mechanical devices employed in filtration have increased in number and variety, until for almost any sort of process the chemical engineer and plant manufacturer have provided the appropriate apparatus. The user, whatever his filtration needs, has now comparatively little to worry about; he has merely to state his needs and it is the business of the specialist to supply them.

MR. J. A. PICKARD
(*Author of "Filtration and Filters."*)

A Great Filtration Textbook

Almost simultaneously with this special filtration number of THE CHEMICAL AGE, the Benn Press issues a great textbook on *Filtration and Filters: An Outline of the Art* (Ernest Benn, Ltd., pp. 488, 45s.), by Mr. J. A. Pickard, B.Sc., F.I.C., A.R.C.S., with a chapter on the mathematical aspects of filtration by Mr. A. J. V. Underwood, M.Sc., A.M.Chem.E., and another by Dr. P. H. Prausnitz giving a compact account of glass filter apparatus. Mr. Pickard, who is well known among industrial chemists as an expert on filtration problems, has sought in this treatise to deal with the whole subject systematically. He examines the general principles of filtration, then discusses the various types of filters, and goes on to consider in detail the filtration of water, air, oils, sugar, beer and wine, varnishes and paints, and other substances. An important chapter is devoted to the new process of metafiltration which is now attracting much attention. Nearly a hundred well-known firms in Great Britain, France, Germany and America have assisted in making the series of illustrations —450 in number—a virtually complete representation of the best modern practice.

Some idea of the scope of this important volume is furnished by the author in his preface. "Any attempt," Mr. Pickard writes, "to include within the covers of a book of moderate size a survey of the field of filtration as a whole must necessarily avoid minute detail. In the following pages an attempt is made to give the subject—which has never before been treated as a whole—in proper perspective, and to show how the fundamental principles underlying all filtration are applied to accomplish the varying duties demanded.

A Survey of the Field

"Generally speaking, filtration is one step in a train of operations resulting in the production of some particular product, and has usually been dealt with under innumerable headings in works devoted to a variety of subjects. In many cases it is one of the most important steps, upon which the quality of the product depends almost more than upon any other. In view of the advances which have taken place in recent years, and the multiplicity of filters now used, it is a matter of great difficulty for anyone primarily occupied with one particular manufacture to keep in touch with all developments, and in the case of new problems it is not easy to discover what filters there are available to produce the result desired. It is hoped that this work will save labour for all in this position, by providing a representative, if not exhaustive, account of the different types of filters in use, and an indication of the most suitable form for producing specific results.

"Processes of filtration, equally with accounts of filters, for the same reason cannot be given with the fullness of detail appropriate to textbooks dealing with the manufactures involved. Other considerations also come in here, for in many cases information is confidential and of a nature which cannot be protected by patents. It is hoped, however, that the information given will enable students and others to get a clear and proportioned view of the size, variety and importance of filtration as undertaken to-day, and will, at any rate, set their feet upon the right road in dealing with filtration problems.

"The classification of filters presents many difficulties, and the author is well aware that the arrangement under the headings chosen is not beyond criticism, and that some types may have an almost equal claim to appear under each of two different headings. As an example, a pulp filter of the enclosed type is clearly also a pressure filter, though described under 'filters employing loose organic filtering material.' Yet it is thought that the grouping made is reasonable and natural, though not rigid or pedantic. In a few cases, where used for one particular service only, as in the case of lubricating oil filters for motor cars, the filters have been described under the 'process' instead of 'plant' heading."

The work is of the highest importance to all engaged in the

filtration industry, and the author expresses hissincere appreciation of the generous assistance rendered to him both by filter makers and users, which alone has made the writing of the book possible, especially to Mr. E. J. Sweetland, of the Oliver United Filters Corporation, and to Mr. E. A. Alliott, of Manlove, Alliott and Co., Ltd.

In the preparation of the following notes we have largely drawn on the contents of Mr. Pickard's book.

What Filtration Really Is

Filtration may be defined as the separation of suspended particles from a fluid by passage through a pervious body. The word " filter " itself is derived through the medieval English and old French word *filtre* from the Latin *filtrum*, meaning " felt," which apparently was the earliest material to be used as a filtering medium. No doubt in consequence of the commonest filtrations being the clarification of turbid water for drinking, or the imparting of brilliance to wine, filtration has been commonly understood loosely as " the removal of solids from liquids by means of porous material," but it is unnecessary to limit the operation in this way, and, indeed, with the great increase in the multiplicity of technical operations which has come about in the past fifty years there are many procedures which would readily be admitted as filtrations which are quite outside the scope of such a definition. The removal of dust from air and of suspended oil from sea water at once suggest themselves. The precise meaning, also, of the word " porous " may be doubted. Is a sponge porous ? Or sand ? Or meshed wire ? In any case the characteristic property of a filtering medium is that it allows a passage for the fluid and refuses it to the suspended matter. So it is preferred to define filtration as " the separation of suspended particles from a fluid by passage through a pervious body."

Scope and Importance in Modern Life

To-day filtration is one of the most important operations employed in industry and public health services. To begin with water, the whole supply of water to practically every large town or civilised district—amounting to very many millions of gallons daily—is filtered ; and not merely roughly strained, but purified from every particle of suspended solids and all traces of pathogenic bacteria. Sand filters of varying types are usually employed for this duty and operate with such efficiency and economy of power as to constitute a very remarkable triumph of chemical engineering. The air employed in ventilating many large buildings, factories, and any places where a dust-free atmosphere is necessary, is filtered with scrupulous care through purifying plant of very different type ; and the dust-laden gases from blast furnaces are also frequently filtered before the gas is employed for power purposes in internal combustion engines, or for heating. In this operation great improvements and developments are now being made.

Sewage, another service of the greatest importance to health and life, is also in many cases purified by filtration, and noxious matter is thereby converted into useful fertiliser and harmless effluent. This is another direction in which progress is still being made and perfection is not yet reached. The milk supply of important centres, when efficiently managed, may also go through a process of filtration by which its keeping properties and value as a food are improved without injuring it or in any way detracting from its vital properties. Beer, again, is a beverage which undergoes the most careful and searching purification by means of filtration. Almost all bottled beer is filtered practically sterile and star bright, usually by means of some form of pulp filter, and, indeed, it would hardly be possible to produce bottled beer which would keep (other than that matured after bottling) without careful filtration. Draught beer is clarified by filtration and fining, and the modern brewery also employs filters for collecting yeast and for mash tun filtration. In some cases filter presses are used, and, less commonly, continuous rotary filters.

In the manufacture of sugar, glucose, and similar products, filtration is carried out in process after process. In beet sugar manufacture filter presses are employed for filtering the liquors after carbonatation, and other forms for clarifying the final liquors before crystallisation. Cane sugar is filtered in the state of crude liquor on the plantation before evaporation to produce raw sugar, and again in the refineries where the most highly purified varieties are made. The removal of the brown colour before the glistening white lump or granulated sugar is produced may be ascribed to filtration. In these operations filters of very varied types are used, from the old bag filters, which have hardly changed in fifty years' practice, to filter presses, char filters, and continuous rotary models of the most modern types.

Oil manufacture again affords a most varied and extensive field for filtration, both in the manufacture of lubricating oil, fuel oil and paraffin wax, and also in the purification of animal and vegetable oils of the most diverse types. Wherever steam is raised there is a need for filters, as all boiler feed water should be filtered, and water-softening plants necessarily incorporate a filter. Oily ballast water from the tanks of ships carrying or burning oil should be filtered before being pumped overboard —in fact, legislation is in hand to make this compulsory, and thus avoid the pollution of navigable waters, with all its accompanying unpleasantness and destruction of bird life.

In the mining industry filtration is constantly employed in dealing with slimes obtained in extracting many different kinds of metals. In short, space does not permit all the applications to be enumerated, and the artificial silk, paint and varnish, chemical and dyeing industries, and many others, must be passed over with a bare mention.

Variety of Forms and Duties

From the vast multiplicity of operations indicated it will be readily gathered that filters must take the most varied forms and operate under extremely different conditions, and in each case the essential factors which determine the form and details of suitable plants will vary. Other factors than the efficiency with which it is possible to carry out the actual separation have to be taken into account—particularly the value of the product and the cost which the operation will bear. As an example, cement slurry may contain 50 per cent. of water, of which quite one half can be removed by filtering, leaving a comparatively dry mass. At first sight it would appear that this operation would entail a very considerable advantage in the manufacture by diminishing the consumption of fuel. Actually, in most cement factories to-day the slurry is run straight into the rotary kilns and the water boiled off, and examination of costs shows that, in an average case, for filtering to show a real advantage it will have to be carried out at a price of about sixpence per ton of slurry.

While it may be quite possible to do this with improved plant, as a matter of fact the cost of running, labour, and replacements on known machines is in excess of the saving they can produce in the operation. At the other end of the scale we may take as an example a filter for purifying and keeping clean the oil in the lubricating system of a motor car. Here the cost of operating is hardly considered, and in some cases the whole filter may be scrapped and replaced after a few thousand miles—the value of the service performed in keeping the engine properly lubricated with clean oil and so avoiding wear and depreciation of the whole machine being out of all proportion to the cost of the filter itself.

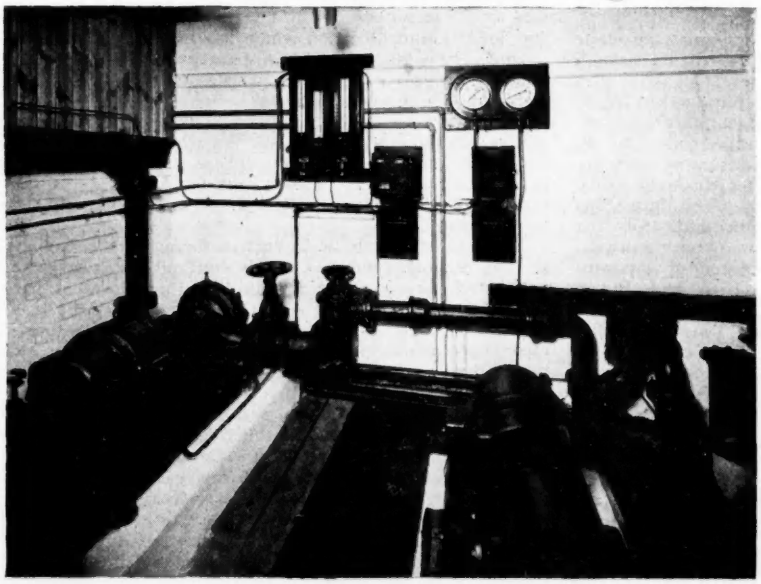
The varieties of filters are, accordingly, extremely numerous —from the small petrol filter weighing a few grams up to water filters containing hundreds of tons of sand and occupying acres of ground. It will be interesting to glance over the development of filters and filtration and see how tremendously this has increased during the last century.

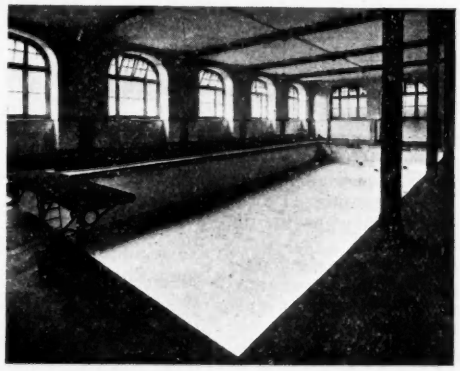
Progress of the Science

Filtration in its simplest form is an operation which has been carried out since civilisation dawned, but it made practically no advance from simple straining through cloth and paper until quite recent times. One may surmise that the operation suggested itself to the earliest observers by their noticing the brightness and purity of water which had trickled through sand, or perhaps had made its way through a sail or a tent covering.

Although the mechanical side of the art up to near the middle of the last century had made but little progress, knowledge of the materials for the construction of filtering media was more advanced. Filtering paper, cloth, felt, and muslin were in common use, and sand and gravel filters were employed widely. For feebly alkaline liquors, linen or calico was utilised, and flannel, twilled woollen cloth, or felt for weak acids. The use of a " pledget " of cotton wool in the neck of a funnel was already known. Strong acid and alkaline liquors were filtered through layers of sand, glass powder, or quartz.

John Benn Hostel Swimming Bath Filtration Plant



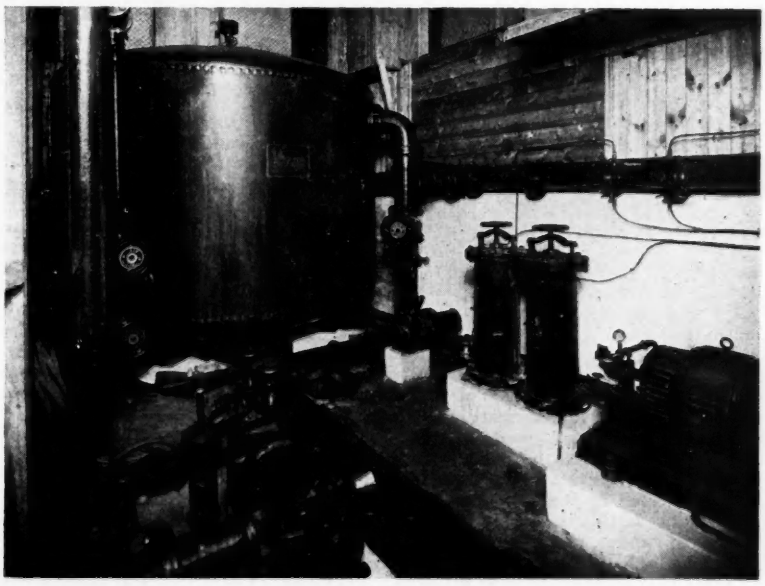


We reproduce on this page photographs of portions of the swimming bath filtration plant which was generously presented recently to the John Benn Hostel, Stepney, by Mr. W. Paterson, of the Paterson Engineering Co., Ltd., Windsor House, Kingsway, W.C.2.

The contents of the swimming bath, amounting to 40,000 gallons, are completely circulated every four hours by means of an electrically driven centrifugal pump, which draws the water from the deep end. The water then passes through the Paterson purification plant, which comprises a coarse strainer for the interception of floating matter, a coagulant feed for the addition of alumina and soda for the coagulation of colour and fine suspended matter, a Paterson air-cleansed pressure filter for the removal of these fine impurities, a Chloronome for the disinfection of the water, and finally an aerator for renewing its sparkling appearance. The purified water is returned to the shallow end of the bath.

This process of circulation and purification goes on continuously, so that the water in the bath is maintained in a clean, hygienic, and attractive condition at all times.

The upper illustration represents the circulating pump and air blower, and the lower the Paterson filter and coagulator. The smaller photograph in the middle gives a general view of the bath.



For the filtration of water, compound filters containing many layers of differing materials were beginning to be employed, and the deodorising and purifying properties of charcoal were known, if not understood. Water was also filtered through the prototype of the Berkefeld and other porous pot filters, which utilised alcarraza, a porous biscuit or stoneware made in Spain and specially imported. A patent for filtration through wire gauze was taken out in 1846.

The germ of the modern filter press was contained in Needham's patent of 1853, which was devised as a means for removing the oil from seeds by pressure and at the same time filtering the oil. In this filter numerous cells were built up by covering wooden surfaces, provided with grooves for drainage, with filter cloth and separating them by battens. The liquid was admitted to the chambers by multiple connections from the supply pipe and the longitudinal pressure was communicated by wedges and tie rods. No delivery channel or separate filtrate taps were provided. Needham, Kite and Finzel introduced improvements in 1856, and the introduction of internal supply channels by Jacquier and Danêk in 1864 brought the development of the filter press very nearly up to the modern designs. With Jacquier and Danêk's press washing through the cake was made possible, and Dehne in 1878 patented a form of washing press with separate conduits for liquor and wash water.

Filter Aids

The use of filter aids, although implicit in many of the processes of filtration employed, was first clearly recognised, as far as kieselguhr is concerned, in the patent of Heddle, Glen and Stuart in 1886, and also in Wiechmann's American Patent No. 343,287. The use of charcoal in powder as decolorising agent and filter aid seems to have been a known art as long ago as the Middle Ages.

A new type of filter was introduced about the year 1890 in the pulp filters which have been so widely used in the brewing trade. The filtering medium here is a thick circular bed of paper pulp which is compressed round a drainage member with central outlet, a number of these units being united with a common delivery and assembled inside a container to which the liquid is pumped under pressure. When it is necessary to clean these filters the whole of the contents must be removed, disintegrated and washed, then re-collected, compressed and replaced. Notwithstanding the extremely laborious nature of the operation, these filters are still widely used.

The present century has seen great developments in mechanical filtration, at the root of which lies the application of vacuum filters to mining slimes by George Moore, developed by him and by Butters and Oliver with the continuous rotary vacuum filter which is so well know to-day. Hand in hand with mechanical progress has gone the development of new filter mediums, of which stoneware of graded porosity, compressed and ignited oxide of aluminium, fritted glass, edge filtration through paper, metafilters and the very interesting class known as ultra-filters may be mentioned.

Filtration of Solids from Gases

From the point of view of underlying theory very little difference exists between filtration of solids from liquids and from gases. Actually in practice some difference exists, as in gas filtration "cake formation" is restricted to the smallest possible amount and a filter is expected to operate, when performing duty, at almost the same output as on clean air. The simplest filters, such as the filtering bags employed in connection with vacuum cleaners, operate by plain straining of the air, the dust particles being larger than the holes in the bag; and bag filters very much resembling these, but on a much larger scale, are employed for cleaning blast-furnace gases. Porous earthenware is also employed for this filtration.

The conditions for gas filtration through pervious bodies differ from those for the filtration of solids from liquids in one important respect. This is in the effect of condensation, or dew-point. Where a gas containing dust and also water vapour is being filtered, the back pressure of the deposited cake and the ease of removing the cake from the filter are both very much affected by the temperature at which the filtration is carried out. If this is high enough to maintain the water in the state of vapour, the cake remains dry and highly porous, and may usually be easily removed by tapping or light brushing. If the temperature is lower, below the dew-point, water settles on the cake, and fills the capillary ducts. This greatly increases the back pressure, and also has a binding effect on the material, which consolidates it as well as attaches it more firmly to the support.

The bulk of the plant employed for removing dust and the like from gases operates in a way which barely comes within the definition of filtration which has been taken.

One very common form of apparatus for dust removal from air is a "cyclone" which consists usually of a cylindrical chamber with a conical bottom. Gas enters tangentially at a high velocity, the dust is carried to the walls by centrifugal action and then falls to the bottom, while the air leaves by a wide central duct at the top. These machines are only able to remove fairly heavy coarse particles, as, on account of the rapidity of motion, light particles are swept along and retained in suspension.

Many filters are built in such a form as to cause the gas passing through them to come in contact with a large surface moistened with some sticky fluid so that the dust particles are retained. The filter is periodically cleaned by washing, and a new coating of adhesive fluid applied. The particular effect upon which this filter relies for its action is the striking of the dust particle on the adhesive surface, so that the conditions necessary for effective action will be: (1) rapid and turbulent flow of the gas, so that the suspended particles are buffeted from side to side as much as possible; (2) minimum distance between the walls, consistent with maintaining the filter open and unchoked with a low back pressure; (3) frequent change of direction in the gas stream. These ends are accomplished in different ways in many industrial machines.

Electrical precipitation is yet another means which is adopted for the removal of both solids and liquids from suspension in gases. Cottrell plants utilise this principle. The gases are caused to pass through pipes which also carry a wire along their longitudinal axis insulated from the walls. Under the influence of a very high difference of voltage set up between this wire and the walls of the pipes the particles are carried to the walls, where they are discharged and fall to the bottom, whence they are removed. Dew-point is again of some importance here, and the other conditions to be observed are rate of flow of gas through the pipes and distance between wire and walls.

Filtration of Liquids from Liquids

A suspension of a liquid in a liquid constitutes an emulsion, and according to the fineness of the particles of the suspended liquid, the difference of specific gravity, and the presence or absence of protective colloids, the emulsion may be permanent or show a tendency to separate. The filtration of one liquid from another can, of course, not take place by arching and cake formation, but pore size in the filtering medium does materially affect the behaviour of the filter. The mechanism of the separation of the two liquids depends usually upon inducing the small droplets to coalesce into larger drops. When this has been accomplished the difficulties of separation are largely overcome, as surface effects are much diminished and gravity can induce settling.

The simplest case of all is probably the wire-gauze petrol filter which is employed in motor cars. This is often of conical shape, the point downwards, petrol flowing in through the sides and up through the base. Water, suspended in droplets in the petrol, reaches the gauze, and if these are small enough to pass through the mesh they do so, with the possible exception of some which actually strike the wires and stick to them. If, however, the drops are too large to pass through without deformation, the difference of pressure on the two sides of the gauze while the filtering is freely passing petrol is too small to effect this deformation. The drop is accordingly arrested, and blanks off part of the filtering surface. When this has gone on long enough to block up some considerable part of the surface, the back pressure of the filter rises enough to effect the deformation and push the drop through. Other droplets, undergoing the same treatment, coalesce with it on the inner side of the gauze and ultimately the drop becomes large and heavy enough to roll down the inside into the point. When enough drops have collected here to produce a small hydrostatic head on the inside, they run through the gauze again to the feed side, where they drop to the bottom of the container.

Filter paper, when filtering oil out of water, acts in very much the same way as wire gauze, but here the pores are much smaller

and longer. At the same time the viscosity of oil is greater, so that much higher pressures are needed to force oil through the capillary tubes of the paper than are necessary to send water through a gauze petrol filter. When filter paper is made use of to take water out of oil—which is frequently done in the laboratory and also, on the commercial scale, to dry transformer oil—the conditions are different. Here the process is complicated by the swelling of the fibres when wet, and it is not possible to get rid of the water entirely by passing any reasonable quantity of dry oil through. So that a filter which may have been passing oil at quite a good rate becomes extremely slow when traces of water are entrained in the oil and absorbed by the paper. The rate in this case is diminished both by the blanking off of part of the filter surface by water temporarily, and more permanently by the swelling of the fibres which diminishes the pore size.

The stream-line ballast water filter operates in quite a different way. In this case droplets of suspended oil are removed from water by the filter, which has an enormous contact surface on which the oil settles and sticks. When the whole of the surface has been covered, the filter ceases to function and then the oil is removed from the surface by the action of live steam. When the contact area has been cleaned in this manner the filter will operate again in the same way as at first.

Filtration of Liquids from Gases

This follows very much on the general lines of the filtration of solids from gases. The commercially important instances of this separation are the removal of sulphur trioxide fumes in the concentration of sulphuric acid ; the removal of a fog or mist from air ; and the separation of oil vapour from compressed gases and prevention loss of oil as oil fog from the crank cases of engines.

Filtering Media

The essential part of filtration is comprised in providing capillary spaces which allow fluids but not suspended matter to pass through. The mechanical arrangement, disposition, and care of this medium are subsidiary.

The removal of the arrested solids and disposal of the clear liquor, the provision of tanks, containers, pumps, and accessory plant belong to the realm of engineering, but the essential and characteristic feature of filtration lies in the capillary channels themselves, their dimensions, shape, and the adsorptive properties and strength of the material in which they are formed.

Filter cloth is the filtering medium which is by far the most widely employed, and a different mechanical means of applying the filter cloth to filtration is usually considered sufficient to constitute a " new filter." There is, however, a wealth of materials at our disposal which may be used to form these capillary spaces, as a glance at the following list, which is far from being complete, will show : Filter cloth (cotton, wool and silk) ; wire gauze ; paper (treated in various ways, pulp and applied as edge filters) ; asbestos (woven, powdered and pulp) ; sand in various sizes ; wood pulp ; charcoal in various sizes and quantities ; limestone and marble ; diatomaceous earth ; porous cellulose ; earthenware and stone (alundum) ; fritted glass ; spun glass ; slag wool ; hard lead, bronze, brass, stainless steel, aluminium, ebonite, celluloid, Bakelite—as edge filters or metafilters.

When a filtration problem first comes up to be settled the whole body of these mediums should be called under review, and in no case should use and wont lead to blind employment of filter cloth only. The factors determining the choice of a medium are : (1) efficiency of filtration ; (2) cost per gallon of filtrate.

Types of Filtration Plant and Materials

Slime and Allied Filtration

In 1902, the necessity of separating a gold- and silver-bearing solution from solid particles in low-grade slime arose at the works of Charles Butters and Co., Ltd. The separation was found to present great difficulties, and ultimately Mr. Butters hit upon the idea of adapting the vacuum leaf-filter

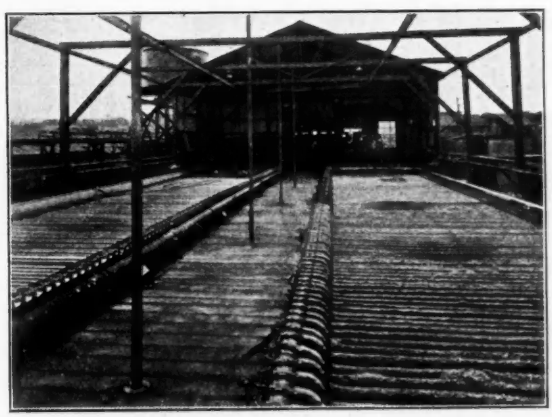
300-Ton Butters Filter at Modderfontein.

for the purpose. From this beginning there have been developed the Butters filters, manufactured by Charles Butters and Co., Ltd., of 54, New Broad Street, London, E.C.

The unit of filtration in the Butters plant is the Butters filter leaf. This may be described, broadly, as a rectangular frame of tubing enclosed within sheets of filter-cloth, and is suspended vertically from a stiff bar or header. The side tubes of the frame have extensions that protrude through the header, the one being connected to the interior of the leaf by means of the bottom tube and the other by the top tube. This provides means by which the space within the leaf may be exhausted by vacuum or subjected to fluid pressure, as desired. In order to prevent the cloths collapsing, when the vacuum is applied, the space between them is filled with coarse fibrous material. The cloths are reinforced by rows of stitching and stiffening strips, which keep them rigid when pressure is applied to the interior of the leaf. The standard size of the leaf is 10 ft. by 5 ft.

Other important parts of the Butters plant are the filter-box, the acid-wash box (used in the Butters patent process for regenerating filter-leaves), the vacuum apparatus, the filter service pump, the valves and fittings, the driving gear, and the acid-wash apparatus.

The Butters filter is employed in separating liquids from a wide range of finely divided solids, such as slime, clay, chemical precipitate and residue, China Clay ; while one very important



1,000-Ton Butters Filter at Crown Mines, Transvaal.

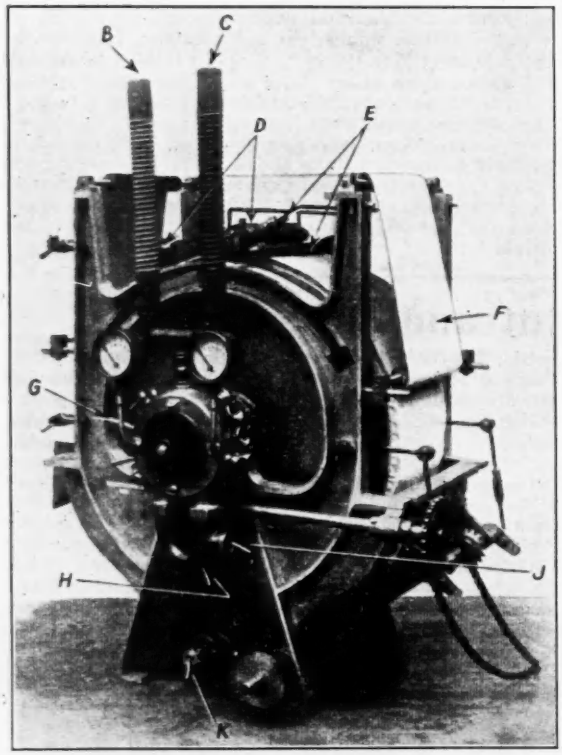
application is to ore-slime in the cyanide and analogous processes, especially in separating and saving the valuable metal-bearing solution, and at the same time dissolving the last traces of soluble metal associated with the ore particles.

Continuous Rotary Filter Plant

A number of special features (covered in Patents Nos. 177,819, 179,494, 218,447, 220,157, 261,140, 287,725; Application No. 32,582/28; and U.S. Patent No. 1,429,918) are mentioned by Wolfe Keene and Co., of Hull, in connection with their rotary filters.

In the automatic valve, the drainage cells from the filter compartments terminate on the periphery rather than on the face or end of the rotating trunnion shaft, as common with other drum filters. This allows for a large internal groove in the form of an annular stationary collar for the collection of the solutions, and the drainage members between low and high vacuum, atmospheric or pressure air, clear and cloudy filtrate and wash effluent, are wearing bridges which automatically take up their wear, being softer material than the rotating trunnion shaft, and define the parts of the valve, metal-to-metal grinding surfaces being entirely eliminated.

The main features here are the continuous compressing endless belt, reciprocating weighted rollers, and total submer

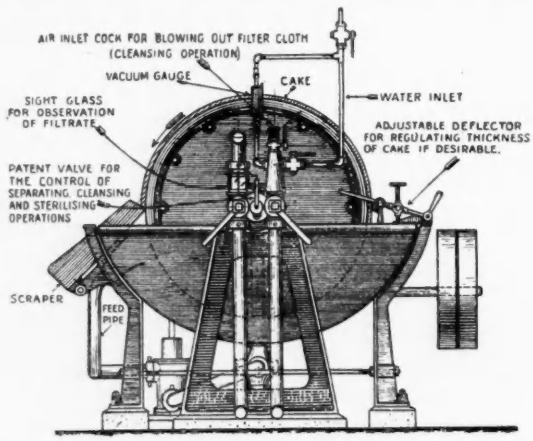


Wolfe Keene's Continuous Rotary Filter: (B) Water Supply for Cleansing Filter Cloth: (C) Steam for Sterilising when required; (D) Compressor Rolls; (E) Water Supply for Washing Cake; (F) Compressor Belt; (G) Vacuum Release for the Cake Release; (H) Filtrate Outlet; (J) Wash Effluent Outlet; (K) Agitator.

gence of cake for washing. The compressor belt is stretched and maintained taut and supported by four fixed idler rollers, which also tangentially direct it upon the cake on the ascending side of the drum and tangentially withdraw it from the descending side to return for continuous operation. This belt is porous enough to admit sufficient air to combine the drying effect of compressing and air drying (as all the air does the work of dewatering) and is driven at similar speed to the filter drum due to surface tensions, no separate drive being required.

The reciprocating rollers, two or more, are weighted or spring-loaded, and are set in motion to and fro upon the belt to mangle and iron out the cake. These rollers are spaced conveniently apart, and operate at a predetermined speed and position over the drum surface, depending upon the material being handled, the motion being suitably synchronised and linked up with the main drive.

As regards the drainage members, no pipes are used, and consequently corrosion and joints are eliminated. A suction and/or pressure communication to the filter compartments is provided through either one or both of the drum-end plates having radial cores diverging from the central cellular facing, to which is mounted in the usual manner a trunnion shaft having communicating cells therein and leading to an automatic vacuum and pressure distributing control valve. In the case of a filter of large diameter, cored radial drum arms are employed, diverging from a cellular facing on the trunnion


AIR INLET COCK FOR BLOWING OUT FILTER CLOTH (CLEANSING OPERATION)
VACUUM GAUGE
CAKE
WATER INLET
SIGHT GLASS FOR OBSERVATION OF FILTRATE
ADJUSTABLE DEFLECTOR FOR REGULATING THICKNESS OF CAKE IF DESIRABLE.
PATENT VALVE FOR THE CONTROL OF SEPARATING, CLEANSING AND STERILISING OPERATIONS
SCRAPER
FEED PIPE

Single Compartment Filter.

shaft, and communicating suction and/or pressure to an end drum ring facing serving to carry and support the filter compartments.

Shallow filter compartments of minimum depth and volume are provided. The drainage is ample even when reduced to $\frac{1}{8}$ in. Also, the suction and/or pressure is distributed in a uniform sideways direction for each filter compartment *via* either the lateral or divisional sealing strips in a stream line manner.

Metafiltration

Metafiltration is a new method of filtering, the apparatus used, the Metafilter, being protected in all countries by J. A. Pickard's patents. The apparatus is supplied by Metafilters, Ltd., of Cecil Chambers, Strand. No cloths, papers, gauzes or pulp are required, and it is claimed that Metafilters may be used at any pressure, any temperature, and with any liquid. Filtration speeds as high as 50 gallons

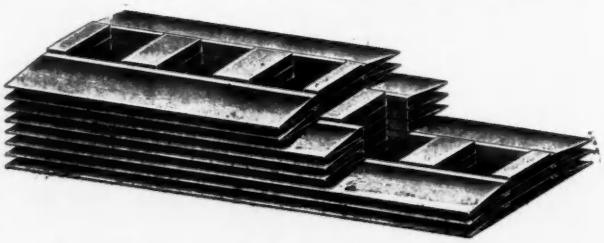


Fig. 1. Magnified View of Metafilter Assembly.

per square foot per hour, with moderate feed pressures, are quite commonly attained with Metafilters.

Metafilters are built up of strips with bevelled edges, one form being shown in Fig. 1. The strips may be constructed of almost any material—ebonite, vulcanite, bakelite, iron, brass, aluminium, gunmetal, Monel metal and a host of others. The strips are kept apart to a definite degree by defining the height of the prominences between the holes, which may be as small as 1/10,000th of an inch, but is more usually 0·5 to 1·5 thousandths of an inch. The strips themselves are very substantial, 1/50th of an inch or more in thickness, and are quite unlike metal foil or paper. Filtration takes place

from the outside to the inside. For fine work a deposit is first formed in the Metafilter by passing through a suspension of a loose porous body such as carbon, kieselguhr, sulphate of lime or other substance. The deposit collects in the V-shaped grooves and forms there a filter bed, which is held in position by the special construction of the Metafilter. This special construction keeps the filter bed in position during filtering

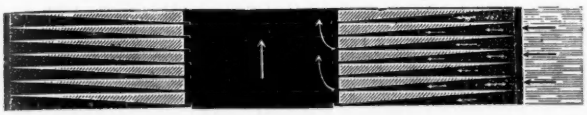


FIG. 2. SECTION THROUGH A METAFILTER, SHOWING FILTER-BED AND DEPOSIT.

and while standing, but at the same time allows of its complete and easy discharge by reverse flow when it is desired to clean the filter.

Fig. 2 shows a section, much magnified, of an assembled Metafilter. In Fig. 3 an elevation, partly in section, of the filter surface is shown. It will be seen that a Metafilter consists of a number of channels narrowing to a fine slit at the inner edge. There is no narrow capillary space behind this edge to choke by gradual accumulation of precipitate. Neither are there any hairs, fibres or porous materials with tiny inaccessible passages which gradually become filled up.

By simply washing back from inside, all accumulated cake, as well as the filter bed itself, is easily discharged, being pushed

FIG. 3. ELEVATION SHOWING EDGES OF STRIPS, AND INTERNAL DRAINAGE CHANNELS.

outwards from narrow to wide parts and falling loose immediately any movement has occurred. Thus, it does not matter how sticky the material may be, or how finely divided the particles, the whole filter is perfectly cleaned equal to new each time. For this reason there is no progressive loss of efficiency, as is the case with cloth or porous filters, during long continued use, but the original output per square foot of filter remains undiminished. Should actual ill-usage occur—such as allowing varnish to dry on the filter—it is practicable to separate and clean the individual strips, but this should never be necessary.

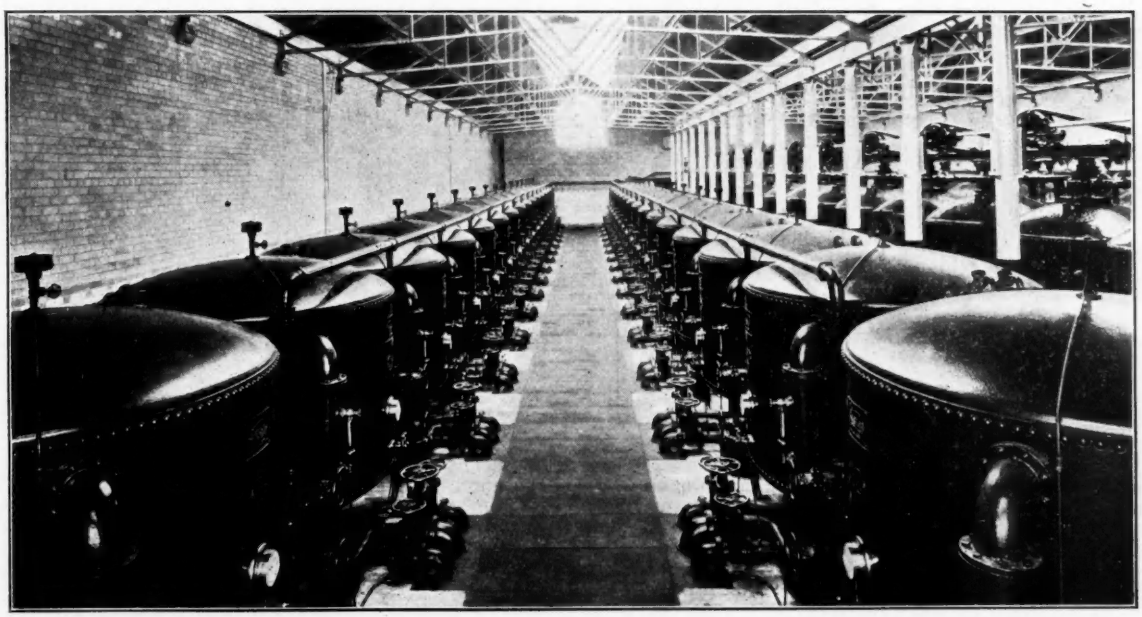
Rapid Sand Filtration

There are three essential differences between the two methods of filtering which are commonly known as slow sand filtration and rapid mechanical filtration. The first is the rate of percolation of the water through the sand bed, which in the rapid filter may be fifty times as great as in the slow sand filter. The question of rapid sand filtration is exhaustively discussed by the Paterson Engineering Co., Ltd., of Windsor House, Kingsway, London, in a booklet entitled *The Purification of Industrial Waters*, the fifth edition of which has just been published, and from which these notes are derived.

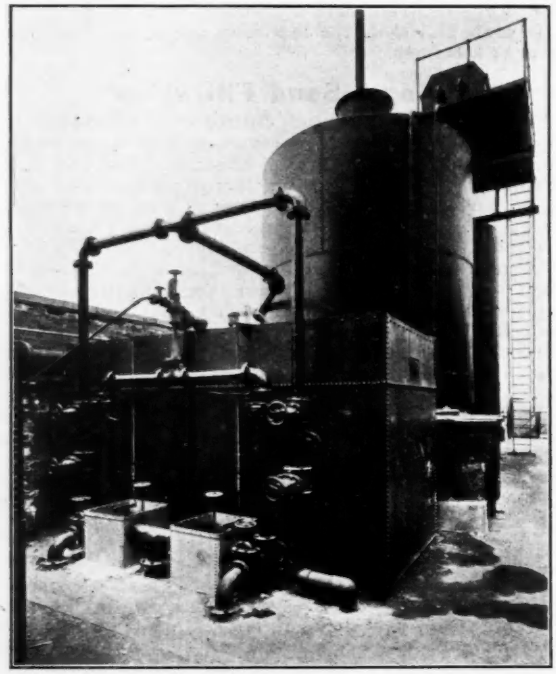
The second of the above-mentioned differences is the method adopted for cleansing the filter bed of accumulated impurities abstracted from the water. In the case of the slow sand filter, these are removed by scraping the surface or excavating the filter bed. In the Paterson rapid sand filter the cleansing is quickly carried out by agitating the filter bed with compressed air admitted from below the filter. This system, which has been used and constantly improved for 25 years, can now be applied to single units having capacities up to 2,000,000 gallons per 24 hours.

The third difference between the slow and rapid filter is the convenience offered by the latter for applying a coagulant to assist the filtration process, particularly where the water contains finely divided impurities. Straining through sand arrests only the grosser impurities, while colour, clay and fine suspended matter freely pass through until the filter is filmed, a natural process in the case of the slow sand filter which may take several weeks to complete. Rapid filtration enables thi to be speedily effected by the addition of a coagulant such as sulphate of alumina.

Rapid sand filters may be of two types: the open or "gravity" type, and the closed or "pressure" type. The latter is so named because it can be interposed on a pressure main without breaking the hydraulic gradient and without occasioning the necessity of repumping. The Paterson company, in addition to both the gravity filter (up to 19 ft. diameter) and pressure type (up to 9 ft. diameter), also supply the horizontal pressure filter. The vertical pressure filter is in practice limited, by pressure considerations, to 8 or 9 ft. diameter. The Paterson system of air cleansing, by dispensing with all rotating stirrers, removes the limitation as to



PATERSON PRESSURE FILTRATION PLANT (SHEFFIELD CORPORATION), CAPACITY 4,500,000 GALLONS PER DAY.

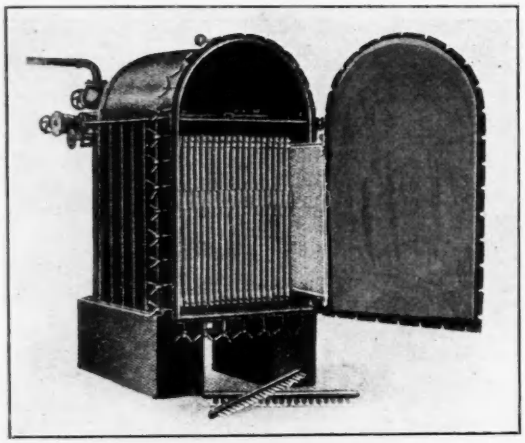


PATERSON COLD PROCESS WATER SOFTENER AND RAPID GRAVITY FILTERS AT PAPER MILL; CAPACITY, 170,000 GALLONS PER DAY.

shape and size of the filter bed, and permits of the application of horizontal pressure filter units of capacity up to 700,000 gallons per day.

The Deposition Filtering Process

In the last few years a new method of filtration has been developed for cases where the liquid filtrate is the valuable constituent and the filtered solid can be rejected. As a filtering medium, asbestos is used. Asbestos is mixed with a small quantity of the liquid to be filtered. The suspension



DEPOSITION FILTER WITH 240 SQ. FT. FILTERING SURFACE

formed is then pumped through wire-gauze frames, on which there is built up a filtering layer of asbestos reinforced by the suspended particles of the liquid to be filtered. The pump is then shut off and the liquid to be filtered allowed to flow into the filter from a vessel placed at a height of 6 to 10 ft. above it. In general, this type of filter (known as the Seitz deposition filter) can only be used for liquids containing not more than 0·5 per cent. of suspended matter. In cases where the greater part of the suspended matter settles out of a liquid, leaving the finest particles in suspension, the supernatant liquid may be treated as above, while the sediment is treated in a press or otherwise.

The Seitz deposition filter is supplied by John C. Carlson, of 149, Farringdon Road, London. It is largely used in the filtration of oils, molasses, lacquer and varnishes, inks, chemical solutions, gelatin, essences, etc.

Industrial Filter Plants

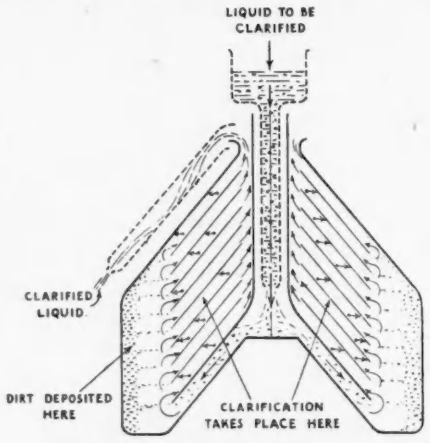
A very extensive range of industrial filter plants is offered by Oliver United Filters, Ltd., of 150, Southampton Row, London, and Bradford, Yorks.

The Oliver continuous rotary drum vacuum filter, which has been an accepted plant in the mining field for the past 20 years, now appears in a remarkably large variety of designs, each suited for special service. Nearly 250 different machines of standard design, comprising 27 distinct types, are listed by the company, and have found successful application in the mining world, the chemical industries, the paper trade, beet sugar, oils, food products, sewage and many other fields of industry. A study of this range of machines of a type forms perhaps the best illustration one could choose to show the great advance which has taken place during recent years in the art of large-scale filtration. It shows the great increase in the application of continuous automatic methods of filtration in industry, and it gives a striking picture of the high technical level to which the art has been raised.

The Sweetland pressure leaf filter is another outstanding product of this company, a machine which is proving itself of great importance on account of its operational savings and special advantages. For high pressures, the Kelly leaf filter is offered, and a further type of pressure filter is the Sweetland cantilever, in which the leaves rotate. The Oliver disc filter is yet another type of continuous rotary vacuum plant, and is particularly suitable where large areas are required. The Oliver-Borden thickener and the Sweetland thickener have had extensive application in conjunction with the rotary vacuum filters, particularly in beet sugar factories. The company also markets a very useful range of dry vacuum pumps and special centrifugal pumps, of both cast-iron and acid-resisting construction.

Clarifiers

In the manufacture and use of varnishes, enamels, paints, lacquers, japans, etc., it is of the utmost importance to keep the material free from impurities which would cause unevenness and spoil the quality of the finished work. In attempting to apply centrifugal clarifiers for the various clarification problems met in the manufacture and use of the above products, the difficulty which is immediately encountered is that



SECTION OF BOWL OF CLARIFIER

a machine which will give satisfactory results with one product will not necessarily give satisfactory results with another product. To meet the demand, special clarifiers have been produced by the Alfa-Laval Co., Ltd., of 34, Grosvenor Road, London. The De Laval clarifiers are now being extensively used by both varnish makers and varnish users for the clarification

of all types of products ranging from clear lacquers and varnishes to heavily pigmented paints.

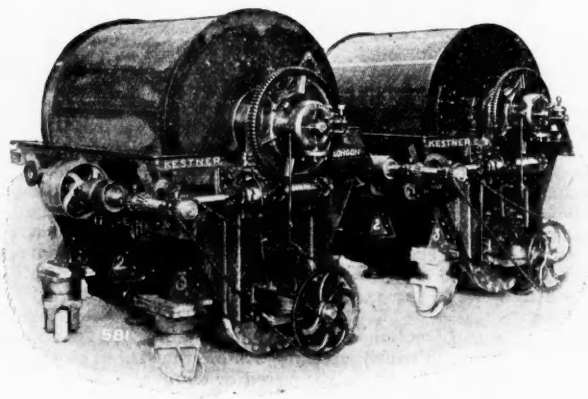
To illustrate how a De Laval clarifier gives constant clarification independent of the length of time during which the machine has been running, the sketch shows a section of the bowl, in which the distance between the clarifying cones has been purposely exaggerated. The direction of the flow of liquid is clearly indicated by the arrows, by following which it will be seen that the liquid to be clarified is split up by means of clarifying cones into a large number of thin layers. Under the action of centrifugal force, any impurity is compelled to travel in the direction shown by the arrows attached to the dots and in a very short time will strike the underneath side of one of the clarifying cones. As soon as the particle reaches the clarifying cone, it slides down the underneath side and is then shot off into the dirt space. In this way, the part of the machine in which clarification takes place is kept free from the impurities extracted and it will thus be seen that the degree of clarification obtained is uninfluenced by the quantity of solid matter in the bowl.

Attention may also be drawn to the De Laval non-aerating separators for use with transformer oils, etc., whereby it is possible to clarify an oil without it coming into contact with air during the process. This method greatly reduces the possibility of oxidation of the oils under treatment. Another development of the De Laval organisation is the production of separators from which it is possible continuously to discharge certain solid materials, so that all bowl cleaning is obviated and the machines can be run for a period of 24 hours without being stopped. These separators are being used with great success in the herring oil and wool-washing industries.

Rotary Vacuum Filters

The Kestner Evaporator and Engineering Co., Ltd., of 5, Grosvenor Gardens, London, S.W.1, specialises in the manufacture of rotary vacuum filters not only for general purposes, but also for special requirements where unusual materials of construction have to be employed and the standard designs have to be modified to suit certain particular conditions. It is difficult, therefore, to give a general account of their productions in the limited space available.

The two filters shown in the illustration were supplied for



TWO SPECIAL KESTNER FILTERS.

dealing with a product for which the usual agitating devices were not suited and usual washing arrangements would be inadequate. A further requirement was that the filters should be constructed in such a way that they were suitable for shipment and the subsequent reassembling abroad. A special form of agitator is fitted, and the driving sprockets to the agitator shafts show clearly at the lower right-hand corner of the photograph. In order to facilitate attention and adjustment, the complete agitating gear can be removed very simply when required.

The washing arrangements are such that very even distribution is obtained on the filter cake, and as four independent wash spray pipes are employed, any one of these can be taken out of action for jet cleaning, or for any other purpose, without seriously affecting the operation of the plant. The spray pipes are arranged with a standard rocking gear which assists in the uniform distribution of the wash liquor.

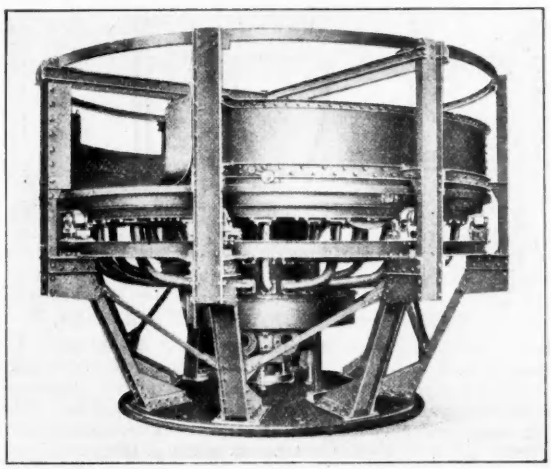
There are other types of filters, notably one in which the whole plant is enclosed and works on a closed circuit, so that liquor with volatile constituents can be handled, and another one in which the usual wiring gear is dispensed with. This type is particularly suitable when the requirements are such that special materials have to be used for construction and a suitable wire cannot be obtained in these materials.

The Kestner filters are constructed with various types of valves for the collection of the filtrate, the type employed depending upon the requirement of each problem. The filters illustrated are each fitted with a valve which separates the main filtrate from the wash liquors.

Rotary Cellular Filters

Cellular filter suction dryers for continuous operation, as patented by R. Wolf, are supplied by Huntingdon, Heberlein and Co., Ltd., of 47–51, King William Street, London, E.C.4. They are built in two standard forms, namely, drum and plane cellular filters, which have as a common feature a suction body divided into numerous chambers or cells.

In the drum cellular filter, a suction drum dips into a trough, from which it draws the mixture. After it has been lifted out, air is drawn through the layer adhering to the drum and carries with it the liquid adhering thereto. Washing



A PLANE CELLULAR FILTER, 90 SQ. FT.

liquid can also be fed on to the precipitate and drawn through. Before reaching the point of immersion the dried cake is scraped off or otherwise removed from the drum.

The filter drum is, in many cases, subdivided into numerous cells with radial partitions. The cells run centrally and are funnel shaped. Each funnel mouth turns sideways internally and runs into a channel which is continued by a corresponding channel in the drum journal screwed against it. The channels in the drum journal terminate at a readily interchangeable front disc, against which the distributor bears. The distributor connects the cells in groups or singly in turn with each inlet and discharge pipe, which can be arranged in various ways according to requirements. The distributor disc, which is perforated and against which lies the front disc of the drum, is interchangeable.

Plane cellular filters have recently been produced for mixtures of coarse substances or substances of high specific gravity, with great success, no matter what the quantity of liquid. The mixture is suction-drained on a revolving ring-shaped plate, washed if necessary, and, after rotation, is drawn off by a delivery device a little way in front of the point of feed. Large outputs up to 20 tons per square yard/hour are obtained, according to the nature of the material.

D

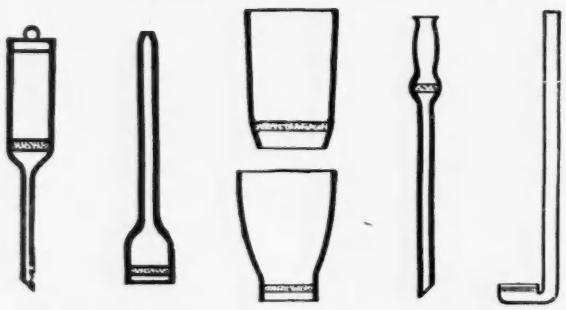
Recessed Plate and Other Filterpresses

Manlove Allcott and Co., Ltd., of Nottingham, manufacture various types of filterpresses, including those with cast-iron recessed plates (not arranged for washing); with cast iron plates and frames (arranged for non-washing or thorough washing); with wood plates and frames (for non-washing or thorough washing), etc. Special attention is paid to such things as closing gears, filter cloths and clips, etc.

Mr. Eustace A. Alliott has made numerous contributions to the literature of the subject of filtration, including the following: "Recessed Plate and Plate and Frame Filter Presses, their Construction and Use" (*J. Soc. Chem. Ind.*, August 31, 1920); "Washing and Wash Ports in connection with 'Chamber' and 'Frame' Filter Presses" (*J. Ind. Eng. Chem.* November, 1921). Reprints of these papers may be obtained on application to the firm.

Glass Filter Apparatus

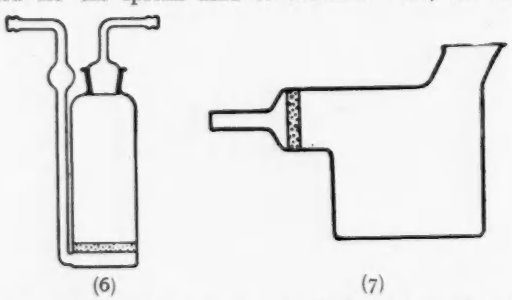
Glass filters are now widely used for a variety of purposes, and the Jenaer Glaswerk Schott und Gen, who are represented in Great Britain by Mr. E. O. Maempel, of Finsbury Pavement House, Moorgate, London, have been engaged in their development. They are made, in general, of a high class laboratory glass, having a low coefficient of expansion



(1) (2) (3) (4) (5)

(1) Glass Filter for α-Cellulose. (2) Glass Immersion Filter. (3) (Top) Fritted Glass Filter Crucible. (Bottom) Fritted Quartz Filter Crucible. (4) Micro-analytical Filter. (5) Gas Filtering and Distributing Tube.

which is perfectly insoluble in water and acids, and only slightly attacked by alkaline liquids. This laboratory glass is ground to powder in ball mills, carefully sifted to certain grain sizes, and the sifted powder formed into porous discs by sintering in clay or iron moulds. The porous discs are then fused into glass containers made of the same glass. The glass containers may be shaped in any desired pattern fitted for the special kind of chemical work, the size of



(6) (7)

(6) Gas Washing Bottle. (7) Microanalytical Filter.

the pores being chosen to meet the wishes of the chemist. The fusion of the filter discs into the clear glass vessels may be done by hand with a blowpipe, or on a lathe specially devised for this purpose.

The degree of porosity in these glass filter discs is not determined, as in the case of porous clay or kaolin filters, by mixing with organic material such as sawdust or sugar, this being burned out and thereby forming the pores; but entirely by the size of grain of the glass powder employed. The larger the grains of glass, the larger are the pores left open when the powder is sintered. In this way it is possible not only to make filters with very small pores of 2, 5 or 10 microns average diameter, but also filters with pores of 50, 100 or 200 microns diameter.

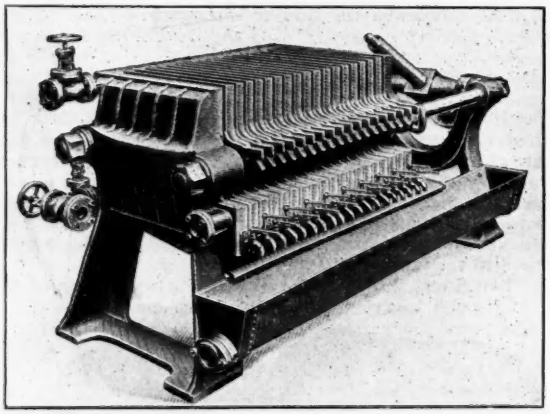
Among the duties for which the filters are suited are the filtration of precipitates, analytical work, the filtration of gases, the filtration of mercury, the distribution of gases in liquids, etc. It is of interest that the filters are said to be able to withstand (depending on the type of filter used) temperatures ranging from 150–600° C. For use at higher temperatures, up to 1,300° C., quartz filters are used. Among the glass apparatus of this type are filter crucibles; Allihn tubes; filters for α-cellulose; gas washing bottles; Buchner funnels, etc. The largest glass filter discs hitherto made have a diameter of about 600 mm.

Filterpresses

The Premier Filterpress Co., Ltd., of Finsbury Pavement House, London, E.C.2, markets the Dehne filterpresses. The latest forms of these are the results of many years of research and experience, and in their design the following ends have been kept in view:—

(1) The largest possible filtering surface in the smallest possible space.

(2) The material that is being filtered is rarely more than from ½ in. to 1 in. distant from the filtering medium. In other words, the filtering surface of the filterpress is very



Iron Filterpress, provided with Heating and Cooling Devices.

large compared with the quantity of material that is actually being filtered at any given time.

(3) In filtration, the question of pressure is extremely important, and with the Dehne filterpress this pressure can be varied from a slight gravitation pressure, obtained from a feed tank placed a few feet above the level of the inlet, up to 10 atmospheres, say 150 lb. per sq. in., or even higher, if necessary.

(4) Simple construction and easy handling.

(5) The ease with which anything soluble that is left in the cakes of solid matter can be recovered or eliminated without having to open the machine.

(6) Durability; there are no parts likely to wear out, nor are there any delicate parts likely to get out of order.

The Dehne filterpress consists of a series of filtering chambers formed by placing alternately a number of solid plates and hollow frames in a framework. The solid plates are provided on each side with a corrugated surface, which allows the filtered liquor to escape easily and at the same time forms a support for the filtercloth. Over each of these solid plates a filtering medium, such as filtercloth, is placed. When the press is closed it comprises, therefore, a series of hollow filtering chambers, each of which is complete in itself. It does not matter how many chambers a filterpress consists of (except, of course, as regards the quantity of material to be dealt with) because the filtration does not start at one end of the press and pass along gradually to the other end

in series, but all chambers start working simultaneously and in parallel, so that, provided that the means of feeding the presses are suitable and adequate, a press with a filtering surface of 1,000 sq. ft. will fill in the same time as one with a filtering surface of, say, 100 sq. ft., and the filtration in each section will be equally efficient.

Although the construction described above of solid plates and hollow frames is the type most generally used, in some cases it is preferable to dispense with the hollow frames (which hold the pressed cake), and to make instead the solid plates with raised margins, so that a cavity is formed between the opposite filtering surfaces which constitutes the filtering chamber and takes the place of the hollow frames. This construction represents the difference between "Frame Presses," where hollow frames are placed alternately between the plates, and "Chamber Presses," in which each filter-plate has raised margins on both sides.

In addition to presses for general purposes, special designs are made for special purposes. For example, filterpresses with heating and cooling arrangements; laboratory filter-presses (with iron, gunmetal, or wooden plates); the "Excelsior" filter, for the clarification of all kinds of turbid and slimy or oily substances; filterpresses with protecting and condensing cover for the filtration of volatile liquors. Other forms of plant supplied by the Premier Filterpress Co. are the osmose or dialysis apparatus; suction (vacuum) filters; sulphur ovens, for the production of sulphur dioxide, etc.

Fine Filtration and Ultrafiltration

A very large selection of apparatus for fine filtration and ultrafiltration is supplied by A. Gallenkamp and Co., Ltd., of 17–19, Sun Street, Finsbury Square, London. The apparatus includes germ-proof filters; water purification filters; porous filtering candles and vessels; Jena glass sintered filters; stream-line filters; ultra-filter apparatus of unglazed porcelain; ultrafilters; bacteria filter for medium pressures; membrane filters, etc.

Perforated Plates

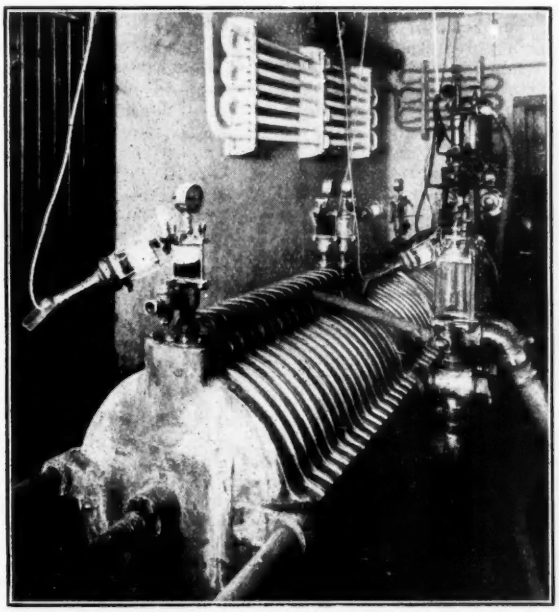
Perforated plates find numerous and varied application in the filtration and allied fields, and their manufacture is obviously a highly-specialised operation. Bamag-Meguin (G.B.), Ltd., of Broadway Buildings, London, S.W.1, manufacture all kinds of them, for all purposes, *i.e.*, with cylindrical or conical round perforations, slot perforations, or square perforations; perforations diagonally or in line, etc. The plates may be of various metals. A speciality of the company is the manufacture of perforated plates in galvanised, zinced, or lead material, and in all special metals such as Armco, Monel, Krupp V2A or V4A steels, bronze, copper, aluminium, etc. Existing screens may be duplicated. The products of the company, of course, include a great variety of other products, among which, in the present connection, may be mentioned screen plates, filter pipes and tubes, grinding mill plates, centrifugal plates and screens, centrifugal sieves, drum screen plates, etc.

Super Horizontal Filters

The ever-increasing demand for efficiency in all industries to-day has resulted in the creation of the new models of the E.U.W. super horizontal filters, manufactured by Anton Petersen and Henius, Ltd., of 69–70, Piccadilly, London.

The E.U.W. horizontal filter completely replaces the previous vertical system. The pressure throughout the filter has not the slightest variation. With a horizontal filter it is possible to dispense with all sieves and grids.

The E.U.W. super filter consists of a portable chassis, which in turn comprises a frame on each end of which is fitted an end plate having square threaded spindles with a hand wheel for operation purposes. Running the whole length of this frame are two filter rods, upon which rest the filter plates themselves, and these plates are pressed together between the end pieces by means of the threaded spindles already referred to. These filters can be either double-spindled or single-spindled, with the other end-piece a fixture in the frame. In addition, a centre piece, either movable or permanently fixed, can be incorporated to permit of various methods of employing the filter. The filter plates are of two kinds, commonly called inlet and outlet plates, and these are inserted alternatively in the framework. The unfiltered liquid is led by canals to each side of each inlet plate, whence it passes through the intervening cakes of filter pulp to the adjoining outlet plates,



AN E.U.W. BRONZE SUPER FILTER WITH ROTARY PRESSURE REGULATING PUMP

from which it flows by other canals to the outlet of the filter. The construction is such that there is absolute security against any contamination between the filtered and unfiltered liquids. In addition, continuous working is obtained by having a fresh set of filter cakes ready, the changing-over process occupying only a few minutes.

Monel Metal Mesh for Filtration

Monel metal wire is finding great application for filter cloth, owing to its toughness and resistance to a wide variety of chemicals, and to the ease with which Monel metal can be drawn down to fine wire and subsequently woven. Over 20,000 of the Shell-Mex petrol delivery pumps throughout the country are equipped with Monel metal mesh, as also are the various petrol pumping stations throughout the Imperial air ports. Very large quantities of Monel metal mesh are used for the filtration of Chile saltpetre, and for mosquito and fly screen throughout the tropics. Waterworks and sewage works are also users, and an important part is played in such industries as the manufacture of dyes, paper, flour, starch, glue, oil, sugar, coal by-products, alum, many foodstuffs, cement, and so on.

Owing probably to the toughness of Monel metal, its resistance to abrasion, combined with its chemical immunity, gives Monel metal filter cloth a very long useful life. Its reliability is also an important factor from the operating chemical engineer's point of view. Finally, it is available in every commercial type of mesh and weave, and rapid deliveries from stock can be given. Monel metal is, of course, handled in Great Britain by Monel-Weir, Ltd., of Cathcart, Glasgow, and a great deal of wire cloth is woven by Wm. Riddell, Cousland and Co., Ltd., of 636, Springfield Road, Bridgeton, Glasgow.

Filtercloths

Tissus Filtrants Hauwel, of Courtrai, Belgium, supply filtercloths of all types, including the following:—Hauwel filtercloths "AAC," for acid filtrations; Hauwel filtercloths "AAL," for alkaline filtrations; Hauwel filtercloths "MB," for industrial ultra-filtration; Hauwel "all-shrunk" filtercloths; and Hauwel twice reinforced filtercloths "Duplo."

Filter Paper

Postlip Mills, at Winchcombe, Cheltenham, are situated in the heart of the Cotswolds, and originated in that spot owing to the excellent water supply, which is unequalled for purity. In olden days, paper mills were scattered all over the country, and the choice of site was largely governed by the available water supply, which was used for motive power as well as for washing purposes. Postlip Mills were running in 1752, as records show, but the date of their inception is unknown. In 1850, the mills passed into the hands of Evans, Adlard and Co., Ltd., and from that date have been noted for the manufacture of "Postlip 633" blotting. It is a recognised fact that British mills make finer blottings than other nations, and "Postlip 633" quality has always retained its high standard for finish, durability and absorbency.

In addition, the firm make tub-sized loft-dried samplings for the sugar, dried fruit and produce trades, and in Mark Lane and Mincing Lane these papers are recognised as pre-eminent, and have held this position for three-quarters of a century. Another of their products is filter paper, which has been one of their foremost lines for over half a century. It was difficult to persuade British chemists to use these papers extensively before the war, as German filterings were then much in demand. The outbreak of war, however, gave English makers a chance which had hitherto been denied them, and so effective was the result that German filterings are rarely asked for now in the home markets. Evans, Adlard and Co., Ltd., were one of the first to seize the opportunity, with the result that their trade in Postlip filtering has increased enormously. Postlip filter papers are made for the purpose of analysis, for technical and pharmaceutical work, and for work on sugar and fruit juices, colours and oils, varnishes, heavy liquids, etc.

Water Purification Plant

Water purification plant for municipal, industrial and other purposes; filtration, aeration and heating plants for swimming baths; water softening and hardening plants; chlorinating plants, etc., are among the products of Bell Brothers (Manchester, 1927), Ltd., of Denton, Manchester, and 99, Abbey House, Westminster, London. Since 1890, when Bell Brothers were among the pioneers of rapid mechanical filtration, the original plants have been modified in many ways and many improvements in design have been made, but the original principles of mechanical agitation for the cleansing of the filter bed have been adhered to. Whilst filtration has occupied a large portion of the company's activities, other problems of water treatment have been investigated and apparatus developed for water softening or hardening, chemical treatment of water, etc.

Among the advantages claimed for the Bell filter are the following: (1) A proper collection of filtered water from all parts of the sand bed; (2) a proper distribution of the wash water over the whole of the bed; (3) efficient methods of agitating the sand during washing; (4) no corrodible metals inside the filter; (5) a proper and efficient method of adding the requisite amounts of chemicals to the water being treated; (6) simplicity of control; (7) proper indicating methods for showing that the filters are doing their work; (8) soundness of construction in all parts; (9) efficient and properly graded filtering medium.

Filter Aids

Johns-Manville Celite filter aids are materials which are manufactured especially for improving the quality of filtration and decreasing the total operating costs. Three of these filter aids are most commonly used for industrial filtration. They are known as "Filtercel," "Standard Supercel" and "Hyflo Supercel." These three grades meet the requirements of a very wide variety of products and conditions. They are uniform powders consisting of practically pure amorphous silica with rigid cellulose structure. The difference between the three filter aids is obtained by a controlled gradation of pore size so that the maximum flow can be obtained for removing a particle of impurity of any given size. These filter aids are widely used for the filtration of sugar, chemical products, glucose, beverages, petroleum, vegetable oils, etc., etc. They are used in conjunction with practically all standard filters. The method of use most generally employed consists in properly mixing a certain quantity of filter aid with the liquid to be filtered and forcing through a filter equipped with suitable cloth.

Johns-Manville Celite Filter Aids and filtration service are provided in Great Britain by Celite Products Corporation, 91, Windsor House, Victoria Street, London, S.W.1.

Filtration Plant

The Lilleshall Co., Ltd., of Oakengates, Shropshire, has been in existence for over 100 years, and is complete with its own collieries, coke ovens, pattern shops, foundry, rolling mills, blast furnaces, steel works, machine and constructional shops, etc. Lilleshall filter presses are made for all purposes, with plates ranging in size from 6 inches square to 6 feet square, with heating and cooling arrangements, etc., recessed type, plate and frame type, etc. The company also manufactures the special plant required for the recovery of gold from tailings and slimes, and another special plant for its collection from extractor boxes.

Specific Gravity

Modern Methods of Determination

In the absence of Mr. W. A. S. Calder, who has recently met with a motor accident, Mr. J. C. Mann presided at the opening meeting of the Midland and Birmingham Section of the Society of Chemical Industry on Thursday, November 21, at the Birmingham Chamber of Commerce.

Mr. W. A. Benton (of the technical staff of Avery's, Ltd., Soho, Birmingham), contributed a paper on "Modern Methods of Determining Gravity." There had been great developments in recent years, he said, in methods and apparatus for determining the relative density of solids, liquids and gases.

Speaking of the newest developments in gravitometers, he said the Avery instrument was first demonstrated before the Physical Society early this year. The object in view in designing the new gravitometer was to produce a device capable of operating at a speed at least two or three times as great as was possible with existing instruments, and at the same time to achieve a degree of accuracy in the determinations comparable with that obtainable when a skilled man used a good balance. To effect these ends it was soon obvious that it would be necessary to eliminate from the process of weighing even the slight friction attending the use of a knife-edge. A freely suspended spiral spring, sufficiently perfect in construction to render its relative extensions capable of accurate calibration, appeared the natural solution.

Details of Gravitometer Construction

The more difficult problems of overcoming the effects of change of temperature on the spring, and of making the instrument work out its own calculations so that only the final result—the required density—had to be attended to by the observer, appeared at first to present serious obstacles to the achievement of success. The solution reached was based on a simple geometrical method of equating the spring extension representing the weight of the displaced water always to the same unitary length, no matter what its actual linear magnitude happened to be. Thus, if the same sample in two successive determinations were weighed first when the temperature was high; and, secondly, when it was low, the greater spring-extensions in the former case, due to decrease in the specific elasticity of the spring, would not affect the final result, because in both determinations the important magnitude, namely, the difference between the extenskons for weighing in air and weighing in water—that is, the weight of the water displaced—would be equated to the same unit length on the graduated bar on which the final determination was read.

To get the result is was not only necessary to weigh the body in air and in water and subtract the latter from the former, but the difference must be divided into the weight of air. This was done automatically on the instrument by the subdivision of the whole of the graduated rule, or such portions of it as were required for indication purposes, in terms of the unit length.

As regards the density of liquids, Mr. Benton made brief references to two or three modern instruments, viz., the total immersion indicating hydrometer, the Mohr-Westphal balance, and an instrument which was a simple modification of the Avery Gravitometer for Solids.

Cellulose in the Paper Industry

Its Production and Treatment

On Wednesday evening, in the rooms of the Chemical Society, Burlington House, London, Mr. James Strachan read a paper entitled "The Production and Treatment of Cellulose in the Paper Industry," before a meeting of the Institution of Chemical Engineers. Mr. J. Arthur Reavell, the president, occupied the chair.

THE world's present requirements and production of paper and paper products are in the neighbourhood of twenty million tons per annum. This quantity may be divided roughly into three approximately equal portions—one-third newsprint, one-third wrapping and packing papers, and one-third book, writing and miscellaneous papers. To-day over 90 per cent. of the world's paper is made from wood cellulose in varying states of purity. In Europe this is derived principally from the forests of Scandinavia and Finland, and in America from the immense woodlands of Canada. North America consumes more paper than all the rest of the civilised world, and Canada may be described as the main source and centre of the world's cellulose.

The chemical engineer, in the practical application of chemistry and physics to the paper industry, is faced with three main problems :—(1) The economical production, conservation and improvement of the supply of wood cellulose ; (2) new methods of production of cellulose from wood and new uses for paper ; (3) new sources of supply for future cellulose requirements.

Raw Materials Used in Paper-making

It must not be supposed that the introduction of wood cellulose to such a predominating extent in the paper industry has removed the older raw materials from the field. These older materials and some new ones are being utilised in increased quantities. The finest paper is still made from cotton and linen rag. Cellulose from straw and esparto grass is being used in increasing quantities. All waste materials from the textile and cordage industries are absorbed, including jute, manila, sisal, ramie and phormium.

So far as present-day raw materials are concerned, however, the main problems of practical chemistry are concerned with the economical production of the highest grade of cellulose from wood. The main supply of wood cellulose is derived from coniferous trees, pine and spruce. A very limited quantity is made from the wood of deciduous trees such as poplar, birch and chestnut. Cellulose from the latter source is only used for special purposes in paper-making. Pine-wood is used extensively in the production of mechanical pulp, which is the principal raw material used in the production of newsprint. Its use in the production of pure cellulose is avoided on account of its high content of rosin. Mechanical pulp or ground-wood, as its name indicates, is purely a mechanical production. In its manufacture the pine-wood logs are barked and ground to a fibrous pulp by pressure against revolving grindstones in a current of water. Mechanical pulp is thus a very impure form of cellulose containing approximately half its weight of the latter. It is the most perishable or least durable of all paper-making materials, and is used only in the cheapest papers.

Chemical wood pulp, or wood cellulose proper, is prepared chiefly from spruce wood. The wood is cut into logs, barked and broken into chips from ½ to 1 in. in length. The wood chips are digested under steam pressure with various chemicals which hydrolyse and dissolve, to any desired extent, the ligneous content of the wood, yielding a more or less pure form of cellulose. The cooked chips are pulped up, washed with water, and in the highest grades of pulp bleached to a white colour with hypochlorite of lime.

Processes for the Production of Cellulose

Chemical processes for the production of cellulose from wood may be divided into three principal groups, described as the (1) sulphite, (2) soda, and (3) sulphate processes.

(1) *The Sulphite Process.*—The wood chips are digested under steam pressure with gradually increasing temperature up to 130° C. to 155° C. in a brick-lined steel digester with liquor containing calcium bisulphite.

(2) *The Soda Process.*—Deciduous woods are cooked by this process and spruce to a limited extent. The chips are digested with dilute caustic soda solution in a steel boiler under steam pressure.

(3) *The Sulphate Process.*—This process is applied to all kinds of coniferous woods for the production of strong brown cellulose known as Kraft pulp, used in the manufacture of strong wrapping paper. The digesting liquor contains both caustic soda and sodium sulphide prepared from black ash.

The bulk of the world's paper is produced from pulp made by the sulphite process. The waste liquor from the process was for many years an absolutely waste product. To-day in many sulphite mills the black liquor from the digesters is fermented for the production of commercial alcohol, and in some instances the value of this by-product is even more than the value of the pulp. In the soda and sulphite processes the used liquors from the digesters are evaporated, burned, lixiviated, and causticised for the production of fresh liquor.

New Methods of Cellulose Production

The main problem presented by the production of cellulose from wood lies in the chemical treatment of the raw material. When we examine the cellulose pulps produced by existing commercial processes we find almost invariably that the purer the cellulose the more it has been subjected to chemical action, injuring the physical properties of the fibre. The strongest cellulose is that produced by the sulphate process, but the production of white cellulose by this process is not so easily controlled as by the sulphite process.

The purest cellulose obtained commercially from wood is isolated by the soda process, but the use of pulp of this kind is rather limited on account of its special physical qualities, which do not lead to its general use as the main raw material for paper-making.

Various methods have been suggested for overcoming the disadvantages presented by the sulphite process, which cannot be said to be an ideal method. A very large field for investigation lies in this direction. The most promising method lies in the use of neutral sodium sulphite, which has apparently practically little or no degrading action on the cellulose itself, when the wood is cooked at a moderate temperature.

One aspect of digestion under pressure in the production of cellulose, not only from wood, but also from other raw materials, which, up to the present, has been almost entirely neglected by research work, is the electrical conditions produced at the surface between the raw material and the surrounding liquor. The movement of the liquor under pressure in the capillary spaces of the raw material gives rise to conditions which resist the penetration of the digesting liquor. By the application of very small electric charges from an outside source the penetration of the fibre may be increased to such an extent that digestion may be carried out at much lower temperatures and with a much smaller consumption of chemicals, accompanied by a marked improvement in the quality of the cellulose produced.

New Raw Materials and New Uses for Paper

Every year new kinds of paper with special physical properties and special applications are being produced with consequent demands on both present and new supplies of raw materials. Although the results of both modern chemical and physical fundamental research indicate that the composition and molecular structure of cellulose is identical in all natural sources of this material, it must be remembered that the form in which the micellæ of cellulose are built up in various plants differs considerably, with the result that the fibre-structure and physical properties of the cellulose vary in different raw materials.

As the increased use of paper is developing for all purposes at a tremendous rate, it is quite evident that the present main source of supply will not meet the demand in coming years. The economic handling of the new materials already in sight, which will certainly take a place with wood in the years to come, is already a present-day problem. These raw materials, such as cereal straws and bamboo, present special problems in handling and treatment owing to the geographical location and mode of growth.

Another problem for the chemical engineer which has received increasing attention during the past century by

paper-makers is the reclamation of waste paper for remanufacture. Scarcely one-tenth part of the paper used to-day finds its way back to the paper mill.

The Physics of Paper Making

The production of cellulose from its sources is very largely a chemical problem. The manufacture of the cellulose into paper is almost entirely a physical one. The principal operations in paper-making from the raw materials to the finished article are concerned almost entirely with the disintegration or partial dispersion of the natural colloidal aggregates we call fibres in water, and their recombination in the form of a continuous aggregate, the physical properties of which are determined principally by the degree of dispersion and the degree of pressure applied in the recombination of the aggregates. The main operations of paper-making must be seen to be closely followed. The first stage in the manufacture—viz., the disintegration or dispersion—is the " beating " process. The reassembling of the beaten fibres into a sheet of paper is accomplished on the paper machine by drainage, drying and pressure.

The most remarkable fact observed in the chemistry of cellulose isolation lies in its extraordinary resistance to chemical action. Parallel with this in the physical operations of paper-making is the resistance of cellulose to deformation under pressure. The actual strength of solid cellulose is of the same order as that of a good quality of mild steel, and its modulus of elasticity closely resembles that of certain metals.

A special branch of paper-making in which the colloidal dispersion of the cellulose is attained by immersion in sulphuric acid is found in the manufacture of vegetable parchment. In this process a degree of dispersion is obtained by this means in a fraction of a second that would require at least 24 to 30 hours of mechanical action in the " beating " process.

The Zeolite Process of Water Softening

Summary of Existing Knowledge

The Department of Scientific and Industrial Research has just issued, as Water Pollution Research Technical Paper No. 1, a pamphlet entitled " Water Softening : The Base-Exchange or Zeolite Process—Summary of Existing Knowledge," by A. R. Martin, Ph.D. (H.M. Stationery Office, pp. 20, 6d.). The report was prepared under the direction of Professor G. T. Morgan, F.R.S., in the Chemical Research Laboratory at Teddington. A condensed account of it appears below.

WATER containing in solution the bicarbonates, sulphates, or chlorides of calcium or magnesium, is termed hard. Such a water will not form a lather with soap until sufficient soap has been employed to precipitate the calcium and magnesium as a curd of oleate or palmitate. When hard water is boiled the bicarbonates are decomposed with evolution of carbon dioxide and precipitation of calcium carbonate. Boiling has no effect on dissolved sulphates and chlorides. Hardness due to bicarbonates is therefore termed temporary and that due to sulphates and chlorides is termed permanent.

Two Methods of Softening

There are two important processes for softening water, the lime-soda and the base-exchange. By the first process sufficient lime (calcium hydroxide) and soda ash (sodium carbonate) are added to precipitate the calcium as normal carbonate and the magnesium as hydroxide. By the second process the property of base exchange possessed by certain hydrated aluminosilicates is employed. Under suitable conditions the metal combined with the aluminosilicate radical can be replaced by other metals, and the process is reversible, that is, the bases of the aluminosilicate are exchangeable, thus :—

$$Na_2O, Al_2O_3, x\,SiO_2, yH_2O + CaCl_2 \rightleftarrows CaO, Al_2O_3, xSiO_2, yH_2O + 2NaCl.$$

When hard water is passed through a bed of the material the calcium and magnesium ions are removed from the water and are replaced by sodium. When the water is no longer effectively softened the material is treated, or regenerated, with brine. The reverse reaction occurs, the sodium aluminosilicate being formed.

The term zeolite, strictly applied, refers to a group of naturally occurring minerals having the property of base exchange. The base-exchange materials supplied for water-softening are sold under trade names or the names of the minerals from which they are derived, *e.g.*, Basex, Borromite, Doucil, Kenzelite, Natrolith, Permutit, Refinite, Zepholite, etc.

Technique of Base-Exchange Water Softening

Large base-exchange water softeners are usually of the pressure type, that is, the water is softened under the pressure existing in the mains without appreciable loss of head. The base-exchange material is contained in closed steel cylinders, usually vertical, but sometimes horizontal. The interior of the cylinders may be covered with a bitumastic enamel to prevent corrosion. The size of a plant with vertical units may vary from a few inches in diameter and 2 ft. in height in a small household water softener to some 9 ft. in diameter and 9 ft. in height in each unit of a large industrial installation, and horizontal units consisting of cylinders 20 ft. long and 8 ft. in diameter are in use.

The brine for regeneration is usually made up in a tank adjacent to the softeners. The concentration generally employed is 5 per cent., but it is often 10 per cent. if the salt recovery system is not used. In the salt-recovery system the spent brine from the previous regeneration is not run to waste, but is used for the first stage of the next regeneration. After this used brine has been in contact with the base-exchange material it is displaced by a freshly made salt solution, and is run to waste. Regeneration is almost complete at the end of the first stage of the process. The time required for a single regeneration varies with the material employed, but is usually from 5 to 20 minutes. The weight of salt required for regeneration is generally about six times the weight of lime (CaO) equivalent to the alkaline earth metal absorbed.

All base-exchange materials are characterised by what is known as their exchange value. This is the weight of the equivalent quantity of lime (CaO) in lbs. (or grains) removed from water by 100 lb. (or by 1 cu. ft.) of material when, under specified conditions, hard water is passed through the softener until the issuing water just ceases to be of zero hardness.

Advantages and Disadvantages

In comparing the base-exchange with the lime-soda process for water softening the chief factors to be considered are :—

(i.) In the base-exchange process the calcium and magnesium salts are replaced by their equivalent of sodium salts. The total weight of dissolved solids is thus slightly increased. In the lime-soda process, if exactly the theoretical quantity of the reagent is added, only the sodium salts equivalent to the permanent hardness remain in the water.

(ii.) The base-exchange process yields a water of zero hardness. The lime-soda process ordinarily yields one of 3° to 4° hardness, and of at least 2°.

(iii.) The base-exchange process automatically adjusts itself to variations in the hardness of the incoming water, whereas the lime-soda process does not.

(iv.) The base-exchange process is inapplicable to turbid, ferruginous, and acid waters. The lime-soda process is unaffected by the water being acid or ferruginous, except in so far as some of the reagent is consumed in neutralising the acidity and precipitating the iron.

(v.) In the lime-soda process difficulties may be experienced in coagulating and settling the fine precipitate of calcium carbonate and magnesium hydroxide, and in disposing of the sludge formed. In the base-exchange process no precipitate is formed and these difficulties do not occur.

(vi.) The base-exchange process can be operated under pressure and thus avoids the re-pumping sometimes required in the lime-soda process.

(vii.) In the base-exchange process there are no moving parts, such as are usually employed in the lime-soda process

in the automatic apportioning devices for adding the reagents.

(viii.) In the base-exchange process there is a risk of loss of material by disintegration and solution, and of a loss of activity.

(ix.) A base-exchange plant usually occupies much less space than a lime-soda plant softening the same amount of water.

(x.) The operating cost of the base-exchange process is lower than that of the lime-soda process for permanent hardness, but is greater for temporary hardness. The capital expenditure involved is dependent on many factors, but under average conditions it is not widely different for the two processes.

It is claimed that the combined process of softening by means of lime and base-exchange material possesses the advantages of the two processes, and that it is particularly suitable for water of a high degree of temporary hardness, since the water so treated does not contain large quantities of sodium bicarbonate.

Water Softening for Boiler Feed

In addition to the general advantages and disadvantages of the base-exchange process already mentioned, the following points require attention when considering the preliminary treatment of water for the production of steam.

The base-exchange process is capable of softening down to zero-hardness. The lime-soda process usually yields a water of 3° to 4° hardness. Even this slight hardness remaining after lime-soda treatment is preferably removed if the water is to be used in high-pressure water-tube boilers.

Caustic Embrittlement.—A characteristic embrittlement and cracking of boilers using natural waters rich in sodium carbonate and poor in sulphate has been termed caustic embrittlement. Parr and Straub state that of a number of cases of boiler embrittlement which they investigated, 70 per cent. occurred with water treated with zeolite, 20 per cent. with water treated with soda ash, and 10 per cent. with untreated water. Parr claims to have shown that embrittlement can be prevented by maintaining the ratio in the feed water of sodium sulphate to the total alkalinity calculated as sodium carbonate at the values, 1, 2 and 3 for boiler pressures of below 150 lb., 150 lb. to 250 lb., and above 250 lb. per square inch respectively. These standards have been recommended by the American Society of Mechanical Engineers, and no case of embrittlement has been reported where they have been adopted.

Corrosion.—A case has been reported in which corrosion due to the evolved carbon dioxide was so serious with a water of a high degree of temporary hardness softened by the base-exchange process that lime-soda softening was readopted. If the water had been treated with sulphuric acid and de-aerated this danger could have been avoided, though the addition of acid requires great care.

The base-exchange process is not recommended for softening water of a high degree of temporary hardness for boiler feed. If water of zero hardness for use in high pressure boilers is required, treatment by the combined lime and base-exchange process should be satisfactory.

Water Softening for Drinking Water Supply

The presence of sodium bicarbonate, the feature of temporarily hard water softened by the base-exchange process, does not appear to accelerate the corrosion of iron supply pipes at ordinary temperature. There is a possibility that objection might be raised to the presence of traces of alumina and silica in water softened by the base-exchange process, but in this connection it should be mentioned that these substances are present in comparable amounts in many natural waters. If the excess lime method of sterilisation is employed, softening can most conveniently be carried out at the same time by the lime-soda process. The base-exchange process, owing to its simplicity, is convenient for small household installations, though small lime-soda softeners, in which the reagents are added in solid form from automatically operated canisters, are in use for this purpose, and they serve to remove iron and correct acidity.

In certain operations in the textile industries and in laundries, water of zero hardness is desirable, and for this reason the base-exchange process of water softening is to be preferred to the lime-soda process. In cases in which water of zero hardness and containing the minimum quantity of sodium bicarbonate is required, the combined lime and base-exchange process is being successfully employed.

The chief methods of preparation of base-exchanging silicates are as follows: (i.) Fusion of appropriate ingredients, such as kaolin, quartz, and soda ash, followed by leaching with hot water. The process has now been largely superseded; (ii.) Precipitation by mixing solutions of sodium aluminate and sodium silicate, usually at temperatures below 20° C. Basex, Doucil and Permutit No. 31 are prepared in this way; (iii.) Treatment of naturally occurring minerals, such as certain greensands (*e.g.*, glauconite) and clays. Borromite, Kenzelite, Natrolith, Refinite and Zepholite are examples of treated minerals.

Theory of Base Exchange

The exchange of one base for another is never complete, but proceeds until an equlibrium depending on the concentrations of the bases in the solution is established. According to one school of thought, base exchange is a heterogeneous chemical reaction governed by the law of mass action. According to another school, it is an adsorption process, kations being adsorbed from the salt solution and equivalent kations expelled from the gel of aluminosilicic acid, *i.e.*, it is an example of the process of exchange adsorption. These two theories have been the subject of much discussion in the scientific literature on base-exchanging silicates.

The following facts are accepted: (1) The equilibrium is a true one and can be established from both sides; (2) The exchange of bases is by equivalents; (3) The anion does not enter into the exchange process.

British Tar or Foreign Bitumen

To the Editor of THE CHEMICAL AGE.

SIR,—I wish to correct certain unjustifiable and most misleading statements which have recently appeared in the Press alleging that bitumen is as British a product as tar, and that those primarily responsible for the campaign in support of British tar are themselves importing foreign stone for use on the roads.

On the first point it should be noted that during the first ten months of this year over 160,000 tons of refined bitumen were imported into this country, quite apart from the bitumen which was produced here from imported crude petroleum. On the other hand, British tar is British in origin and manufacture; it is produced in British works from British coal. Bitumen, by contrast, is of foreign origin. That is beyond dispute. At best, for a proportion of the bitumen used here, the raw material—crude petroleum—is brought from abroad to be refined in this country, while at worst, refined bitumen is imported as a manufactured article, in the production of which no penny of wages is paid to British workpeople.

As for the second point, the use of British tar on our roads has recently been advocated by Members of Parliament, surveyors, coke-oven managers and others, and one does not readily identify any of those whose letters and articles have appeared in the Press with the importation of foreign stone at any time, for many years past.

To take two instances at random, Sir Henry Page Croft, and Mr. Will Thorne, M.P., representing, respectively, Conservative and Labour points of view, have advanced the direct plea that British tar should be used on British roads in the interest of the great organised industries—gas, coke, steel and coal—which depend, each in a greater or less degree, on a home market for tar. Such support for British tar can scarcely be brushed on one side by a casual reference to those who import foreign stone.—Yours, etc.,

ARTHUR E. COLLINS.

10, Cambridge Road, Colchester.
November 23.

Solvents Institute Founded in U.S.

THE SOLVENTS INSTITUTE, INC., was incorporated in May of this year under the laws of the State of New York as a non-capital stock corporation. The charter members were the American Solvents and Chemical Corporation, E. I. du Pont de Nemours and Co., Inc., Franco-American Chemical Works, Inc., the Kessler Chemical Co., the Merrimac Chemical Co., the U.S. Industrial Chemical Co., Inc., and Van Schaack Bros. Chemical Works, Inc. The institute is primarily concerned with solvents of the ester and commercially related types, although its certificate of incorporation and its name cover all solvents. One of the first projects of the new institute is to establish standards and to provide for co-ordinated research.

Fumes from Power Stations

The Interim Report of the Government Committee

A White Paper just issued by the Ministry of Transport is entitled "Treatment of Sulphur Fumes in connection with the working of the proposed Electric Power Station of the London Power Co. at Battersea" (H.M. Stationery Office, pp. 10, 6d.). It gives the interim report of the advisers to the London Power Co. and also that of the committee presided over by the Government Chemist.

THE interim report of the committee presided over by the Government Chemist, Sir Robert Robertson, is signed by him and by Dr. C. H. Lander, Mr. J. Macintyre, and Dr. T. Lewis Bailey. It is as follows:—

We are now able to make an interim report in accordance with the terms of the letter of May 25, 1927, in which we were asked "to keep in touch with the progress of the investigations made by the London Power Co. in connection with the problem of elimination of sulphur fumes in connection with the working of the proposed Battersea Power Station, and in conjunction with the Department of Scientific and Industrial Research, to advise the First Commissioner of Works and the Electricity Commissioners as to the efficacy of the measures proposed to be adopted in this respect." We have had the opportunity of examining in detail the interim report of the London Power Co. to the Electricity Commissioners on their experimental work for the removal of sulphurous fumes from flue gases.

The Experimental Work

Generally, we may say at the start that we consider the experimental work so far reported indicates that by the use of water sprays in their experimental apparatus, it is possible to eliminate from the gases of combustion nearly the whole of the sulphur gases present. In addition to seeing the interim report of the Advisers to the Power Co., we had the opportunity of inspecting the experimental arrangements while in operation at Grove Road on July 8, 1929, when neither acid taste nor objectionable odour could be detected by breathing the undiluted treated gases coming from the exit flue.

The analytical results as regards acidity of ingoing and outgoing gases during an experimental run at Grove Road were checked by a representative of the Government Laboratory, and the absorption of about 95 per cent. of the sulphur acids in the flue gases was confirmed.

Experiments in Larger Plant Awaited

From what we have seen of the process in its small experimental stage, while we consider that it has afforded results that are promising, we consider that there are features in the experimental apparatus and process which are still obscure, so that, while we think there is no inherent reason why similar results should not be obtained from the larger experimental plant now being erected on the lines of a projected installation at Battersea, we prefer to await the results afforded by this larger experiment. We think it necessary that a more definite explanation of the mechanism of the oxidation of sulphurous to sulphuric acid in the experimental process should be forthcoming before we can report on the practicability of the process.

The Effluent Question

In connection with this power station, very large quantities of condenser water are to be used, as much as 500 tons, we were informed, for every ton of coal burned. A portion only of this quantity should be required for washing the gases. We have ascertained that the alkalinity of Thames tidal water near Battersea is about 20 parts per 100,000. Five hundred tons of such water would have twice as much alkalinity as is necessary to neutralise the sulphur acids derived from one ton of coal containing 1·5 per cent. of total sulphur, even assuming that no sulphur remains in the clinker.

Under these conditions there is no chance of an acid effluent going into the river if all the condenser water is systematically utilised for neutralisation, and this condenser water before being withdrawn maintains the required alkalinity, but there is a chance of some calcium sulphite remaining in solution. This, although a neutral salt, might be objected to, on account of its property of further depleting the river of oxygen. From the ready oxidisability of sulphurous acid and sulphites, their total conversion into sulphuric acid and sulphates should be easy, in which case the effluent water at Battersea would still retain a certain alkalinity, and would be altered only in the sense of having in solution a small quantity of innocuous calcium sulphate.

We understand that mechanical separators are to be used for eliminating the bulk of the dust; the washing process which the gases undergo for removal of sulphur acids should prevent the escape of most of the residual dust particles, but we have no experimental data on this aspect of the question.

Report of the Company's Advisers

The interim report of the advisers to the London Power Co. is signed by Dr. E. Ardern (consulting chemist to the Manchester General Rivers Committee) and Professor R. V. Wheeler (head of the department of fuel technology at Sheffield University). The report, entitled "The Treatment of Flue Gases: Interim Report on Tests of Proposed Treatment," points out that the treatment of the flue gases from a power-plant, so as to render them inoffensive to the neighbourhood, demands the removal of smoke, dust and sulphurous gases.

In a modern power-plant, with automatic chain-grate stoking, the prevention of smoke and the removal of dust present little difficulty. Combustion control can be so perfect that there is no excuse for smoke formation, whilst proved methods of dust-removal, of high efficiency, are available. There remains the problem of the removal of sulphur gases. As a matter of principle, the coal used should contain as low a proportion of sulphur as possible. This report records the results of experiments made to test the efficiency and practicability of a scheme of removal of sulphur gases by washing with water which, on theoretical grounds, seemed to be reasonable to the signatories.

There is then described an investigation carried out at Grove Road Power Station in the period April-August, 1929, in which the flue gases were scrubbed with water (experiments being made with both hot and cold water). From the tests with cold water it is concluded that, when the time of contact with the flue gases is over 12 secs., there is complete removal of the sulphur gases. Even when the time of contact was as low as 7 secs., 90 per cent. of the sulphur gases were removed.

In the tests using hot water (145° F., the temperature of the gases being 190° F. on entering), it is found that the SO_2 of the flue gases was converted to SO_3, and the sulphur gases may be removed by the use of comparatively small quantities of water. The manner in which the transformation from SO_2 to SO_3 is effected is still the subject of experiment.

Practical Application of the Experiments

As a result of the experiments at the Grove Road Station Dr. Ardern and Professor Wheeler state that, it having been found that the amount of water required effectively to remove the sulphur gases from flue gases, even when their concentration is high, is not excessive, a scheme for the treatment of the gases at the Battersea Power Station was drawn up.

This scheme more than fulfils the requirements (as regards, for example, the time of contact of the flue gases with the wash-water) indicated by the Grove Road experiments, and allows for an additional treatment, a final washing with a slightly alkaline solution, which they do not consider will be necessary. Provision has been made for the insertion of packing material (rough-sawn boards on edge) both in the downtakes from the main flue and in the uptakes to the chimney-stacks. The Grove Road experiments indicate that but little packing material will be required, the sprays in the main flue alone, with perhaps some packing in the downtakes, being sufficiently effective. To guard against the emission from the chimney stacks of gases saturated with water-vapour, with consequent condensation in cold weather, arrangements are provided for delivering hot and dry air to the stacks, either just above the "eliminator plates" (which will trap entrained moisture) or at any point higher up the stacks.

As regards the neutralisation of the wash-water, this will be effected by mingling with the "condenser" water, the volume of which will be about 40 times that of the wash-water.

Progress of the Dyestuffs Patent Action

The I.G. Case for Amendment

As reported in THE CHEMICAL AGE last week, Mr. Justice Maugham, on Thursday, November 21, in the Chancery Division, began the hearing of a motion of the respondents, the I.G. Farbenindustrie Aktiengesellschaft, in the matter of latters patent Nos. 193,834, 193,866, and 199,771, under the Patents and Designs Acts 1907 to 1919, and a petition of Imperial Chemical Industries, Ltd., in the matter of the same patents. Professor A. Smithells is sitting with the judge as chemical assessor.

On Friday, November 22, the hearing was resumed, and Mr. Whitehead continued his opening for the owners of the patents. He gave illustrations of various formulæ by means of models, and said that they seemed to be all in plane form. A good deal of recent work done by Sir Wm. Bragg and his son, Professor W. L. Bragg, had shown a remarkable tendency among these bodies to subsist in the plane form. This work had been carried out with X-rays. No doubt Prof. Smithells would turn his attention to this matter at the end of the case.

His Lordship said that Prof. Smithells had told him that he had been paying attention to it for the past 20 years.

Mr. Whitehead said he did not suggest that Prof. Smithells would learn anything from this case.

Advantages of Azo Dyes

Mr. Whitehead said that many of the loveliest dyes were the worst from a practical point of view. He went on to explain that the advantages of azo dyes were the ease and rapidity of dyeing, and fastness to light, rubbing and washing, and in regard to cotton goods, to kier boiling. There was no dye which would stand any amount of kier boiling. What the chemist had to do was to supply a dye which would stand kier boiling, bleaching and light.

Counsel then proceeded to read the specifications of the three patents in question and the hearing was adjourned.

On Monday, November 25, Mr. Whitehead continued his opening, and dealt with the allegation of the petitioners that the existence of the patents greatly hampered them in their business. He said that the only meaning that could be attached to that was that the petitioners desired to make use of the inventions protected by these patents, and must have said so in their application for the fiat of the Attorney-General. Whatever might be said by way of particular attack against the patents, it was quite clear that there could be no general attack against the utility of any of these inventions.

What the petitioners were saying was this: If you look at the specification of the old patent of 1912 you will find that it claims in general and wide terms the manufacture of azo dyestuffs, and the more particular examples which are being claimed in the patents in the suit are in truth included within the old manufacture, so that if these patents are good that in effect amounts to an extension or perpetuation of part of the original monoply. That was what he understood to be really the substance of the petitioners' case.

A Green Dyestuff

Although there were over nine million components to select from, nobody up to the present time had succeeded in making a satisfactory green azo dyestuff. Any number of chemists had been trying to do so. What an extraordinary and remarkable thing it would be, if, after all these years, somebody was fortunate enough either by research or lucky chance, to discover it, and could not, according to the petitioners, have a patent for it—no reward for his labour—because it infringed a patent still in force.

Whatever the result of this case, said counsel, it was a matter of considerable importance to the chemical industry and his clients. There was plenty of research work being carried out in this country with regard to azo dyes, where different components were being coupled together, and if the respondents could not get patents neither could anyone else.

Counsel then dealt with prior documents and submitted that they did not show any anticipation. He contended that this patent could not be destroyed in law for want of subject-matter. He mentioned that there were 70 objections to the validity of the patents. He asserted that he would prove that the patents contained novelty of invention.

He submitted that if he established the need or desire for these dyestuffs, fast to kier boiling, and if he showed that these inventions had provided dyestuffs fast to kier boiling, then by reason of the nature of that problem itself and the length of time before it was solved, it could not be said it was obvious, without experiment and research, that the problem could be solved in a way it had been solved by these inventions. If it did require invention and research, then, on the authorities, the patent must be held to be valid.

On Tuesday, Mr. Whitehead resumed his address. He said that he made a mistake the previous day when he said that no satisfactory azo green dyestuff had been made. What he ought to have said was that no satisfactory monazo green dyestuff had been made.

On Wednesday, Mr. Whitehead, continuing his address, stated that the respondents' reasons for making amendments to their patents were for the purpose of more clearly defining the nature of the inventions described in the specifications, and for the purpose of limiting by way of disclaimer the monopolies claimed. The amendments were opposed by Imperial Chemical Industries on the ground that instead of limiting the monopolies they would enable the respondents to claim inventions substantially different from the inventions already claimed. Broadly speaking, added counsel, an amendment by way of disclaimer was almost invariably allowed, but it was a matter for the discretion of the court. He argued that the respondent could by way of amendment disclaim invalid clauses in the patent.

His Lordship: I understand your contention is that unless the amendment is substantially different, I ought, *prima facia*, to allow it?

Mr. Whitehead: That is so.

The Question of Disclaimers

His Lordship: I hesitate to accept the view that all disclaimers should be allowed. I should hesitate to allow disclaimers which I thought patentee wrongfully enlarged, in the sense that he had no reasonable ground to establish what he claimed.

Mr. Whitehead: That depends upon the evidence brought forward?

His Lordship: No doubt.

Mr. Whitehead said it was known the legislature took the view that specifications of many good inventions were too wide, that it amended the statute.

Mr. Cripps said that was so. In the Act of 1883 there was a clause dealing with amendments. There was then no change till 1919, when the powers of the Court were extended.

Dealing with the specification of the respondent's patent for monazo dyestuffs, Mr. Whitehead said it was proposed to limit the claim to combinations with halogenated components. The patentees wished to jettison the monopoly so far as the manufacture in substance was concerned and to limit it to the particular method whereby dyestuffs were made on the body to be dyed, *i.e.*, dyeing on the fibre. That was the effective way in which the invention was used, and he was ready to accept that as an amendment. All the examples cited in the specification referred to the diazo compounds of the benzene series. They did not intend to cover any dyestuffs which contained a diazo component other than one of the benzene series. He was also seeking to exclude from his claim bodies which had a nitro group. Another proposed amendment was by striking out particular examples because they were better commercial dyes within the ambit of the monopoly. The patentees believed that they would have effective monopoly by restricting the specification to halogenated components. With regard to the specification relating to the manufacture of azo dyestuffs by coupling diazo compounds with an oroth-alkyloxy anilide, counsel said the proposed amendment followed the lines of those already given.

Mr. Whitehead said these were the amendments he sought, and he would now call evidence.

Dr. Otto Oberlander said he had been engaged in the production of dyestuffs. He was familiar with the class of dyestuffs in question and their application. He practised as a consulting chemist, and was acquainted with dyeing, kier boiling and bleaching. He found that boiling objects in

caustic soda had not the deleterious effect upon cotton that bleaching had. Under the old process to get a fast dye took many weeks. Under the azo process the time had been shortened to 10 days or a fortnight. Apart from rapidity of production, the advantages of the German company's patents were ease of work, fastness to light, rubbing and washing, and equality of shade.

On Thursday Dr. Overlander gave further evidence in support of the respondents' case as to the novelty and utility of the patents and the beneficial property of the dyestuffs combination, showing very good results indeed. Witness said he had conducted experiments with some hanks of cotton dyed by the respondents. The hanks were kier boiled for 10 or 12 hours in 0·8 per cent. caustic soda. The results were generally satisfactory. The test was a practical one inasmuch as the hanks were boiled with goods that were to be sold commercially. The patented group of dyestuffs showed a marked fastness to kier boiling. The dyestuffs were all monazo dyestuffs.

Cross-examined: He had acted for the I.G. since it was formed. It was a combination of German dye companies. It was the practice here to classify the results of tests made of dyestuffs for fastness. Witness had not, however, classified his results. He had merely contrasted one with the other.

The hearing is proceeding.

"The Chemist and Commerce"

First Gluckstein Memorial Lecture

THE first S. M. Gluckstein memorial lecture will be delivered by Dr. Leslie H. Lampitt at the Institute on Friday, December 13, at 8 p.m., Professor Arthur Smithells (President of the Institute of Chemistry) in the chair. Dr. Lampitt has chosen for his subject, "The Chemist and Commerce."

The late Mr. S. M. Gluckstein, a director of J. Lyons and Co., Ltd., read before the London and South-Eastern Counties Section in October, 1927, a paper entitled "Chemistry and Dividends," in which he gave an account of the development of the chemical staff and laboratories of his company, illustrating the bearing of science, and particularly chemistry, on the management of a large industrial undertaking. He showed how the services of chemists had been appreciated by the directors, giving a frank expression of his views based on the experience gained over a period of eight years during which the laboratory staff of the company had been gradually increased to 72 chemists and assistants, now accommodated in the laboratories at Kensington opened this year, of which Mr. Gluckstein, who died on August 29, 1928, did not live to see the completion.

In memory of the director who had taken so great an interest in their work, the staff of the laboratory, of which Dr. Lampitt is the head, offered the Council of the Institute a sum of approximately £200 to administer this fund for the provision of an annual lecture, the purpose of which is to show the bearing of science on industry, particularly in various fields of chemical activity. The lecture will be open to members of other societies and to the public.

Judgment on Underwriting Contract

BEFORE the Court of Appeal on Friday, November 22, was the resumed hearing of an appeal by North British Artificial Silk, Ltd., a company formed in 1928, with a capital of £345,000, to carry on the manufacture of artificial silk, from a judgment of Mr. Justice Rowlatt in favour of the Tokenhouse Securities Corporation, Ltd., from whom they had claimed £19,425 under an underwriting agreement. By the agreement the defendants undertook to procure sub-underwriting in respect of shares in the plaintiff company. They procured a number of contracts, which the plaintiffs alleged were worthless, and tendered cheques which were dishonoured. The defence pleaded was that once the plaintiffs had accepted the applications and made allotment the agreement had been fulfilled, even if the applications proved worthless, and that the defendants were under no further liability. Mr. Justice Rowlatt held that the plaintiffs had not made out their case under the terms of the agreement, and entered judgment for the defendants. Lords Justices Greer and Slesser concurred.

I.G.-Standard Oil Agreement

World Rights of Coal Oil Production

ACCORDING to the official report of the board meeting of the I.G. Farbenindustrie A.-G., which was held at Leverkusen on Saturday, November 23, on the return of several of the concern's directors from New York, a definite agreement on the following general lines is stated to have been reached after prolonged negotiations between the I.G. and the Standard Oil Co. of New Jersey:—

The patents of the I.G. and the Standard Oil Co. concerning the distillation of coal and oil, for the whole world, with the exception of Germany, are to be taken over by a new company, which will be owned by both parties and managed by the Standard Oil Co. The report does not give any details regarding the capitalisation of the new undertaking, nor concerning the respective participations of the two groups in it. A special agreement is contemplated concerning the sale of the I.G.'s synthetic petrol in Germany on conditions which would protect the rights and interests of the I.G.

An Important Agreement

The importance of the agreement consists in the fact that the I.G. is accorded a preferential position in Germany in addition to financial advantages, whereas for the rest of the world its distillation process, in co-operation with the oil group, can be developed further economically. Since the distillation process places the oil industry on a new economic technical basis, both parties were convinced that the new agreement would enhance this new development and accelerate the economic application of the process. It is stated that the I.G. will derive considerable sums from the agreement with the Standard Oil Co.

The I.G.'s business for the first nine months of the current year was reported to show a further all-round increase in the general turnover as compared with the preceding year. Its financial position is satisfactory, bank debts having been reduced from 82,000,000 marks at the end of 1928 to 38,000,000 marks, and credit balance with banks amount to about 120,000,000 marks. So far as can be foreseen at present and under the usual reserves, the same dividend as last year—*i.e.*, 12 per cent.—can be anticipated.

New Headquarters for Levers

Great Rebuilding Scheme

PREPARATIONS for one of the largest business moves in recent years are being made by Lever Brothers. Owing to the developments resulting from their fusion with the Margarine Union Co., their present headquarters, which are considerably out of date, have been found inadequate. Lever House, on the Embankment, London, formerly De Keyser's Hotel, and which during the war was taken over for a time by the Government for the Air Ministry, is therefore to be demolished. Negotiations are now taking place for temporary quarters in the City. On the site of Lever House it is proposed to build a vast modern structure at a cost exceeding £1,000,000 sterling. It is expected that the work will take approximately three years to complete, and it is understood that the Margarine Union, which is now proposing to increase its capital to £11,500,000 (by the creation of 1,000,000 7 per cent. cumulative preferred shares and 6,500,000 ordinary shares of £1), will be mainly responsible for the work.

The new building will be the world-wide headquarters of this combine, whose capital amounts to more than £25,000,000. The associated firms occupying offices in Lever House are: Anglo-Nigerian Exploration, Ltd., Medley and Son, Ltd., Associated Enterprises, Ltd., Blondeau et Cie, De Bruyn, Ltd., Distributors and Transporters, Ltd., Glycerine, Ltd., Lever Brothers (South Africa), Ltd., Lever Brothers (India), Ltd., Lever House Advertising Service, Ltd., Levers Pacific Plantations Ltd., Lever Stores, Ltd., Moor Park, Ltd., Moor Park Country Club Co., Ltd.

The new building will, it is understood, occupy the same area as the present Lever House, but it will be carried several storeys higher. The combined staffs of the several firms number, probably, about 1,200, and as it would not be possible to accommodate them all, even temporarily, in one building, it is believed they will be divided between several premises in the City of London offering suitable accommodation.

Chemical Matters in Parliament

Artificial Silk Factories

Mr. Pethick Lawrence (House of Commons, November 20), stated in a reply to Mr. Kelly that there are 32 Customs and Excise officers employed solely in artificial silk factories. The remainder of the work in connection with the duties on artificial silk was performed by officers on a part-time basis in conjunction with their other duties.

River Pollution

Mr. Freeman asked the Minister of Agriculture (House of Commons, November 21) whether, in view of the growing and serious menace of river pollution all over the country and of the inadequacy of existing powers to deal with the matter, other action was contemplated to deal with the situation; and, if so, what? Mr. Greenwood said that the whole question of river pollution was at present under consideration by the Joint Advisory Committee on River Pollution and in particular they were considering measures to prevent pollution by trade effluents. They had issued a preliminary report in which they expressed the opinion that much more could be done, under existing powers, through the appointment of joint committees by the councils of counties and county boroughs. He was urging the authorities to set up such bodies.

Works Committees

In reply to a question by Mr. Mander (House of Commons, November 25), regarding the number of works councils established in factories in this country, Mr. Clynes referred him to the Memorandum on Works Committees furnished by the Ministry of Labour to the Committee on Industry and Trade which appears on pages 302-306 of the Committee's "Survey of Industrial Relations," published in 1926. It would appear from the estimate given in that Memorandum that, up to and including 1922, considerably over 1,000 works committees had been formed but that this figure (which embraced other industries besides factory industries) had since then been substantially reduced, and he understood that the information at present available is not sufficient to enable any revised estimate to be given. He added that the number of special safety committees which had been set up in factories with the express object of promoting safe conditions of work had considerably increased of late in the circumstances explained in the Report of the Chief Inspector of Factories for 1928 (pages 14-22)

Cocaine and Cocaine Hydrochloride

Mr. Day enquired of the Home Secretary (House of Commons, November 25) as to the amount of cocaine and cocaine hydrochloride that had been manufactured in Great Britain under the authority of the Home Office during the past three years. Mr. Clynes stated that since the coming into force of the Dangerous Drugs Acts no cocaine was manufactured until 1928, when 1,047 ounces of cocaine and 3,887 ounces of the salts of cocaine were manufactured under Home Office licence.

Narcotic Drugs

Mr. Clynes, replying to Mrs. Hamilton (House of Commons, November 25), stated that the maximum requirements in Great Britain and Northern Ireland in 1928, of raw opium and cocaine, according to the estimate of the Health Committee of the League of Nations, were: 45,263 lb. of raw opium and 704 lb. of cocaine. The quantities manufactured in Great Britain in 1928 of the drugs to which the Dangerous Drugs Acts apply were as follows: Medicinal opium, 6,859 lb.; morphine and its salts 9,056 lb. (including 4,868 lb. used in the manufacture of derivatives of opium or morphine which are not within the Dangerous Drugs Acts); diacetylmorphine and its salts, 675 lb.; cocaine and its salts, 308 lb. The quantities exported in 1928 were: raw opium, 15,856 lb.; medicinal opium, 3,394 lb.; morphine and its salts 3,114, lb.; diacetylmorphine and its salts, 377 lb.; cocaine and its salts, 278 lb.

Sugar Beet Factories

Mr. Haslam asked the Minister of Agriculture (House of Commons, November 25) whether, in view of the Witham river fishery disaster, and without prejudice to any legal action arising therefrom, he would expedite his inquiries into the means of rendering the effluents from sugar beet factories innocuous so that appropriate action might be taken by those factories that had not already done so at the earliest possible moment? Mr. N. Buxton said that the Ministry of Agriculture and Fisheries was not in a position to conduct inquiries into the treatment of factory effluents. Investigations of the purification of effluents from beet sugar factories were, however, being carried out by the Department of Scientific and Industrial Research with the co-operation of the industry, and were proceeding as rapidly as possible. The industry was being kept in close touch with the progress of the investigation. Other investigations were, he understood, being conducted by a committee appointed by the factory owners themselves.

Scientific Glassware

Mr. Harris (House of Commons, November 27) moved that an humble address be presented to His Majesty praying that so much of the Draft Order in Council, presented to the House on November 5, 1929, as relates to the making of scientific glassware, be annulled. It was, he contended, likely to be very injurious to the trade throughout the country. Under the Merchandise Marks Act, 1926, goods finished in this country, but on which part of the earlier work had been done abroad, had to be branded as of foreign manufacture. It was not fair to English manufacturers to stamp glass "Made in Germany." Injury was thus inflicted upon an important and useful industry that employed highly-skilled men with good wages. Mr. W. Smith (Parliamentary Secretary to the Board of Trade) explained, in reply, that it was the duty of his Department to carry out the terms of the Act. He had added to the number of small glass articles which need not be marked. The department had offered to assist with regard to blanks which, after passing through processes here, were re-exported. He suggested that a better way of dealing with the matter was to take advantage of a section of the Act which provided that if an order, after it was made, reflected hardship on a trade, the department had power to eliminate from the order the particular article with regard to which the hardship arose. Chemists and scientists had, however, written to him that it was important they should know the origin of the glass.

The prayer was defeated by 132 to 32.

Death of Dr. Samuel Rideal

We regret to announce the death of Dr. Samuel Rideal, D.Sc., F.I.C., which occurred suddenly at Hartley, Southern Rhodesia, on November 13.

Dr. Rideal, who was 66 years of age, was the son of Mr. John Rideal, of Sydenham, and was educated at Dulwich College, the Royal School of Mines, and University College, London. He was University scholar in chemistry in 1884, and an assistant in the chemical laboratory, and was elected a Fellow of the University College in 1887. Later he lectured on chemistry at St. George's Hospital Medical School. He was an eminent authority on water purification and sewage, disinfection and food preservation. His *Practical Inorganic Chemistry*, *Disinfection and Disinfectants*, *Water and Its Purification*, *Public Water Supplies* (with his son, Dr. Eric Rideal), *Sewage and the Bacterial Purification of Sewage*, and *Industrial Chemistry*, appearing between 1889 and 1918, were valuable works which established his reputation. He was made a Fellow and member of council of the Sanitary Institute, served as president of the Society of Public Analysts (he had been public analyst of Chelsea) and of the Association of Sewage Works Managers, was Cantor lecturer to the Royal Society of Arts on water purification, and served as examiner in chemistry to the Royal College of Physicians. In July, 1914, he was chosen as the prospective Liberal candidate for Salisbury, but the War broke out and he did not stand at the General Election of 1918.

Dr. Rideal married Lilla, daughter of the late Mr. Samuel Keightley, J.P., of Bangor, Co. Down, and sister of Sir Samuel Keightley, barrister and novelist, and had three sons and one daughter. One son, Dr. Eric Rideal, is Humphrey Owen Jones lecturer in physical chemistry at Cambridge and Fellow of Trinity Hall.

Appointments Vacant

Chemist with experience in manufacture of fine chemicals. Details on p. xlv.

Three shift managers, an electrical engineer, and a mechanical engineer, for an Indian chemical works. Details on p. xlv.

From Week to Week

PATENT RESEARCH, INC., announce the removal of their offices to the Lefcourt National Building, 521, Fifth Avenue, New York.

MR. EDWARD RUSSELL, B.Sc., F.I.C., has been re-elected chairman of the Bristol and South Western Counties section of the Institute of Chemistry.

JOHN WILLIAM LIDDLE, aged 25, fell through a glass roof while working at the synthetic works at Billingham on Monday, being sightly injured.

Dr. STANLEY G. WILLIMOTT, A.I.C., has been appointed Government chemist in Cyprus, and is shortly leaving to take up the appointment. Dr. Willimott is an old boy of the Collegiate School, Liverpool. In 1917 he joined the Royal Engineers and served in France, working with the Gas Corps. He had afterwards a distinguished career at Liverpool University and at Cambridge, and holds a doctorate of each university.

MR. H. S. HORNE has resigned his directorship of the British Cement Products and Finance Co., Ltd. In his letter of resignation he intimated that it had become necessary for him to file his petition. The directors of the company, in making the announcement, state that the financial position of the company is not affected. Mr. Horne's petition was presented at the Bankruptcy Court on Wednesday, and a receiving order was made.

THE BIRMINGHAM SECTION of the Institute of Chemistry has arranged for a whist drive to be held at the Midland Hotel, New Street, Birmingham, on Saturday, December 7, at 7.30 p.m. A limited number of tickets are available to members of the Society of Chemical Industry who are not already members of the Institute of Chemistry, and may be obtained only on application to Dr. F. W. Norris, 91, Witherford Way, Selly Oak.

AT AN EXTRAORDINARY GENERAL MEETING of shareholders of Bolckow, Vaughan and Co., Ltd., in Manchester on Tuesday, the proposal to effect an amalgamation with Dorman, Long and Co., Ltd., was approved, and for that purpose it was decided that the company be wound up voluntarily and that Mr. S. W. Rawson, secretary of the company, be appointed liquidator. The chairman, the Hon. Roland D. Kitson, stated that the provisional agreement for amalgamation had now been accepted by all those whose consent was necessary in both companies.

THE INSTITUTE OF FUEL will hold its next meeting in the rooms of the Chemical Society, Burlington House, London, on Wednesday, December 11, when a paper will be presented on "The Coal Burning Art as Applied to Steam Production," by Mr. W. D. Wylde, F.Inst.F. Owing to the author's absence abroad, the paper will be presented and the discussion replied to by Mr. H. L. Pirie, M.I.Mech.E., F.Inst.F., joint honorary secretary of the Institute. The chair will be taken at 6 p.m. by Mr. W. F. Goodrich, F.Inst.F. Friends of members are cordially invited to attend and take part in the discussion. Advance copies of the paper may be obtained on application to Mr. P. C. Pope, the secretary.

THREE POPULAR LECTURES will be given at the Cardiff Technical College during December, in order to bring to the notice of the public the activities of the Society of Chemical Industry, as follows: "Dyes," by Dr. F. Arnall, on Thursday, December 5, at 7.30 p.m.; "The Search for Drugs to Cure Disease," by Dr. J. H. Quastel, Director of Research Laboratories, Cardiff City Mental Hospital, on Tuesday, December 10, at 7.30 p.m.; and "X-Rays," by Mr. W. Somerville Vernon, on Tuesday, December 17, at 7.30 p.m. Admission to any or all of these meetings will be free (by ticket), available on application to the Assistant Hon. Sec., Mr. E. A. Rudge, at the Technical College, Cardiff.

THE CHEMICAL SOCIETY will hold an ordinary scientific meeting on Thursday, December 5, at 8 p.m. The following papers will be read:—"Passivity of metals. Part III. The quantity and distribution of the superficial oxide," by U. R. Evans and J. Stockdale; "The argentothiosulphuric acids and their derivatives. Part I. The preparation of the sodium salts and the isolation of monoargentomonothiosulphuric acid," by H. Baines; "Sugar carbonates. Part IV. The dicarbonates of glucose, fructose, mannose, galactose and arabinose," by W. N. Haworth and C. R. Porter; and "Isolation of crystalline-α and β-ethylglucofuranosides (γ-ethylglucosides) and other crystalline derivatives of glucofuranose," by W. N. Haworth and C. R. Porter.

"PETROLEUM AND PETROLEUM GASES AS CHEMICAL RAW MATERIALS" is the title of a paper by Mr. H. M. Stanley which will be read at a meeting of the Birmingham and Midland Section of the Society of Chemical Industry on Thursday, December 5. Petroleum hydrocarbons, and especially hydrocarbon gases derived from petroleum, are becoming increasingly important as starting materials for the manufacture of alcohols, glycols, and their derivatives. Many of these processes are applicable to the gaseous hydrocarbon constituents of coke-oven gas, etc. Already certain organic chemicals, which until recently were rarities, are being manufactured on a large scale from such raw materials. Mr. Stanley will deal with these points.

INDIAN INDIGO EXPORTS during September amounted to 44 cwt., as compared with 103 cwt. in September, 1928, and 254 cwt. in September, 1927.

UNIVERSITY NEWS:—*London.*—Dr. G. A. Harrison, M.D., B.A., has been appointed to the University Readership in Chemical Pathology tenable at St. Bartholomew's Hospital Medical College.

MR. ROBERT MOND has made a gift of £25,000 to the extension fund of the Infants Hospital, Westminster, London, of which he is honorary treasurer. The gift is payable over the next seven years.

WELSH TINPLATE MANUFACTURERS and those of France and Germany are reported to have in view negotiations regarding the delimitation of markets on similar lines to the arrangements now existing between Wales and the United States.

AN EXPLOSION occurred at the Bede Metal Company's works at Hebburn-on-Tyne on Tuesday. A furnace was blown out and a workshop damaged. John Moran, Charles Derbyshire, James Gibson, and John Halliday were taken to hospital, where Moran died on Wednesday.

THE TIN PRODUCERS' ASSOCIATION (INCORPORATED) held an extraordinary general meeting on Wednesday, Sir Philip Cunliffe-Lister presiding. The question of regulation of supplies was discussed. An official communication was afterwards issued, stating that the scheme, prepared by the executive committee, endorsed by the council, and circulated in advance to members, was carried unanimously. The council was authorised by the terms of the resolution to take the necessary steps to carry the scheme into effect.

PREPARATIONS ARE BEING COMPLETED for the annual service of remembrance to the 386 men of the South Metropolitan Gas Co. who lost their lives in the war. The service will be held at Southwark Cathedral on December 7. The Bishop of Woolwich and Canon J. B. Haldane, the Precentor, will take part, and the sermon will be preached by the Rev. F. H. Gillingham (the well-known cricketer), rector of Lee. Members of the Old Comrades' Association, headed by the Metrogas Military Band, will march to the Cathedral.

MR. HERBERT W. ROWELL, in a lecture on synthetic resins delivered to the Liverpool Section of the Society of Chemical Industry on Friday, November 22, said that very few of the resinoids produced synthetically in the labarotory had proved to be useful commercially, and about 95 per cent. of the trade was confined to the phenolaldehyde type. The industry was growing rapidly, and the world output was now about 18,000 tons of pure resinoid per annum, which was manufactured into nearly three times that weight of finished articles.

LABORATORY WORK in its relation to public welfare was the subject of a lecture which Dr. R. M. Buchanan, of the Public Health Department of the Corporation of Glasgow, delivered on Wednesday, November 20, to the members of the Glasgow Athenæum Club. It was to the honour of Glasgow, Dr. Buchanan remarked, that the first laboratory for the experimental teaching of chemistry was instituted there just 100 years ago. The Glasgow Technical College was the oldest technical college in the world. It was the first institution of its kind to admit women for instruction on the same footing as men.

F.B.I. REPRESENTATIVES have met the authorities of the Inland Revenue at Somerset House so as to discuss income-tax allowances on industrial plant. This question, which is a highly technical one, is nevertheless of considerable importance to industry, especially as the present position tends, in the opinion of the F.B.I., to discourage the initiative of manufacturers at a time when every encouragement should be given them. The Federation urges that the recommendations of the Royal Commission on the income-tax with regard to obsolescence should be given effect to. The Royal Commission recommended that the allowance for obsolescence "should be given in the case of machinery or plant disused for any reason, whether replaced or not, except where the disuse is the result of the discontinuance of a business."

CONTINUOUS COAL CARBONISATION state in a progress report that, as a result of further research work, supplementary patents have been filed dealing with the detailed mechanical perfections of the company's continuous automatic process. Searching tests of the new features have been completed, and while this has involved some considerable expenditure, the board consider it has been justified. Dense, hard, and smokeless briquettes of excellent quality have been produced, it is stated, while the automatic plant enables the oils to be removed at the temperature at which they are evolved, thus preventing their decomposition. It is added that favourable financial rearrangements and terms have been negotiated with the Incandescent Heat Co. which will enable the company to proceed with the erection of the new plant at Erith and with commercial development. The new plant should be in full operation at an early date.

Obituary

DR. HERMANN OPPENHEIMER, director of the Oranienburg works of Deutschen Gasglühlicht-Auer-Gesellschaft m.b.H., on November 17, aged 53. He had been with the company for 22 years.

References to Current Literature

British

ANALYSIS.—The estimation of citronellal and citral in Australian essential oils. A. R. Penfold and W. G. Arneman. *Perfumery and Essential Oil Record*, October, pp. 392–395.

ELECTROCHEMISTRY.—Some new aspects of the electro chemical oxidation of organic and inorganic compounds. III.—Electrochemistry and biochemistry. F. Fichter. *J.S.C.I.*, November 15, pp. 341–344T.

GASES.—Oxygen and hydrogen in industry. W. P. Dobson and A. S. L. Barnes. *Canadian Chemistry and Metallurgy*, November, pp. 16–18, 29.

GENERAL.—Titanium dioxide and its cosmetical uses. H. S. Redgrove. *Perfumery and Essential Oil Record*, October, pp. 408–410.

MICROSCOPY.—New methods in microscopy and their effects on industry. C. P. Eden. *Chemical Engineering and Mining Review*, October 5, pp. 30–34. Special reference is made to the Australian dairy industry.

OILS, ESSENTIAL.—The essential oils of *Podocarpus totara* and *Podocarpus dacridiodes*. H. A. A. Aitken. *J.S.C.I.*, November 15, pp. 344–346T.

PLANT.—The wood tank and vat in the process industries: Why and where this type of equipment is finding an expanding market in the chemical field. *Canadian Chemistry and Metallurgy*, November, pp. 24–27.

TAR.—Free carbon formation in coal tars and pitches. W. G. Adam and G. S. Sach. *J.S.C.I.*, November 15, pp. 337–341T.

United States

ANALYSIS.—Proposed thiosulphate number for olive oil. W. H. Dickhart. *Oil and Fat Industries*, November, p. 271

Gravimetric determination of sodium by the urany zinc acetate method. II.—Application in the presence of rubidium, cæsium, potassium, lithium, phosphate or arsenate. H. H. Barber and I. M. Kolthoff. *J. Amer. Chem. Soc.*, November, pp. 3233–3237.

Zirconium. V.—Detection of traces of potassium in the presence of zirconium. R. D. Reed and J. R. Withrow. *J. Amer. Chem. Soc.*, November, pp. 3238–3241.

APPARATUS.—A simple laboratory vacuum regulator. W. E. Kuentzel. *J. Amer. Chem. Soc.*, November, pp. 3347–3349.

Automatic cut-off device for a gas-fired laboratory mercury still. W. E. Kuentzel. *J. Amer. Chem. Soc.*, November, pp. 3349–3351.

DYESTUFFS.—Cleavage of azo dyes by means of sulphites. The cleavage of 4-hydroxyazobenzene-5-carboxylic acid and of 3-methyl-4-hydroxyazobenzene-5-carboxylic acid. K. H. Engel. *J. Amer. Chem. Soc.*, November, pp. 3483–3489.

GENERAL.—The permeability of hot metals to hydrogen. B. C. Hendricks and R. R. Ralston. *J. Amer. Chem. Soc.*, November, pp. 3278–3285. Zinc is permeable to hydrogen at temperatures between 305° C. and the melting point; oxygen-free copper is permeable to hydrogen at 500° C. and above.

The composition of Philippine bagasse. A. Valenzuela and A. P. West. *Philippine Journ. Science*, October, pp. 275–281. Bagasse contains about 45 per cent. of alpha-cellulose, 30 per cent. pentosans, and 15 per cent. lignin.

Laboratory testing of germicides and chemotherapeutic agents. O. Schöbl. *Philippine Journ. Science*, October, pp. 283–289.

Solubilities of oils and waxes in organic solvents. J. W. Poole. *Ind. Eng. Chem.*, November 1, pp. 1098–1102.

Solubility of ethylene glycol. H. M. Trimble and G. E. Frazer. *Ind. Eng. Chem.*, November 1, pp. 1063–1065.

SHALE OIL.—Refining of shale gasoline. I.—Relation of oxidation to colours and gums produced in gasoline from Colorado oil shales. R. A. Baxter. *Ind. Eng. Chem.*, November 1, pp. 1096–1098.

SUGAR.—The manufacture of sugar from nipa sap. M. L. Roxas. *Philippine Journ. Science*, October, pp. 185–229.

German

ANALYSIS.—The quantitative detection of fats in drugs. E. Glaser and A. Halberstam. *Archiv Pharmazie*, October, pp. 526–532.

FERTILISERS.—The physiologically acid nature of potassium fertilisers. *Chemiker-Zeitung*, November 23, p. 909.

GENERAL.—The electrolytic production of hydroxylamine. II.—The simultaneous application of the oxidation and reduction processes. J. Stscherbakow and D. Libina. *Zeitschrift Elektrochemie*, November, pp. 826–830.

A contribution to the tetrahedral theory of the carbon atom. R. Hönig. *Zeitschrift Elektrochemie*, November, pp. 847–851.

The C-A-S process for the production of ammonium sulphate. A. Salmony. *Chemiker-Zeitung*, November 23, pp. 909–910.

A sensitive method for the determination of the melting point of gelatin gels. W. Matthaes. *Chemiker-Zeitung*, November 23, p. 910.

Highly active bleaching earths. A. Scholz. *Chemiker-Zeitung*, November 20, p. 899.

Reactivity and physiological action. K. Kindler. *Archiv Pharmazie*, October, pp. 541–555.

ORGANIC.—The pyrogenetic degradation of cyclic hydroxy-acids: Salicylic acid, protocatechuic acid, gallic acid, *o*-coumaric acid, caffeic acid, and some of their derivatives, alone and in the presence of phloroglucinol, aniline and pyridine. H. Kunz-Krause and P. Manicke. *Archiv Pharmazie*, October, pp. 555–571.

The preparation of derivatives of phthalide. F. Mayer, W. Schüfer and J. Rosenbach. *Archiv Pharmazie*, October, pp. 571–582.

PLANT.—Modern deep well centrifugal pumps. *Chemiker-Zeitung*, November 20, pp. 899–900.

Small electric heating elements for the direct production of hot water from the cold water supply. *Chemiker-Zeitung*, November 20, p. 900.

Miscellaneous

ANALYSIS.—Citronellal. III.—The determination of citronellal. H. J. Waterman and E. B. Elsbach. *Recueil Travaux Chimiques Pays-Bas*, November 15, pp. 1087–1091 (in English).

The detection and determination of the carboxyl group by means of distillation with zinc dust in a current hydrogen. A. W. van der Haar. *Recueil Travaux Chimiques Pays-Bas*, November 15, pp. 1170–1174 (in German).

Argentometric studies. II.—A note on the estimation of halides in the presence of sulphites. O. Tomicek and A. Jansky. *Collection of Czechoslovak Chemical Communications*, November, pp. 582–584 (in English).

The determination of iodides and bromides in chlorides. O. Tomicek and A. Jansky. *Collection of Czechoslovak Chemical Communications*, November, pp. 584–605 (in English).

APPARATUS.—A trap for carrying out reactions in an inert atmosphere. H. Gilman and A. P. Hewlett. *Recueil Travaux Chimiques Pays-Bas*, November 15, pp. 1124–1128 (in English).

GENERAL.—The decomposition of $CaCO_3.6H_2O$ into anhydrous $CaCO_3$. H. G. Roebersen. *Recueil Travaux Chimiques Pays-Bas*, November 15, pp. 1218–1226 (in German).

Promoter action in the cabalytic oxidation of methane with steam. R. Kubota and T. Yamanaka. *Bulletin Chem. Soc. Japan*, October, pp. 211–220 (in English). The largest quantity of CO_2 was obtained by promoting the catalyst with Al_2O_3, while when water vapour was regulated, the catalyst promoted with MgO gave the largest yield of CO.

SUGAR.—The ternary system strontium oxide-cane sugar-water. I. and II.—W. Reinders and A. Klinkenberg. *Recueil Travaux Chimiques Pays-Bas*, November 15, pp. 1227–1245, 1246–1264 (in German).

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Complete Specifications

320,056. Water Soluble Condensation Products and Technical Applications Thereof. A. Carpmael, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, June 28, 1928.

These condensation products are obtained by condensing a hydroxyl derivative of an aromatic sulphonic acid with the halogenated aralkyl halide. Condensation is effected in sulphuric acid solution, the mixture being stirred for several hours until the evolution of hydrogen halide ceases. These condensation products have good tanning properties and are applicable as resists for dyeing and printing. Examples of hydroxyl derivatives of aromatic sulphonic acids include the sulphonic acids of phenols, cresol halogen phenols, naphthols, etc. Examples are given of the condensation of these with chlorbenzylchloride, etc., and the application to dyeing is described.

320,125. Concentrated Nitric Acid from Weak Solutions, Production of. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, July 7, 1928.

It is known that nitric acid can be extracted from its aqueous solutions by means of liquid nitrogen tetroxide, and concentrated nitric acid obtained by expelling the nitrogen tetroxide, but large quantities of nitrogen tetroxide are necessary owing to the fact that nitric acid is soluble in liquid nitrogen tetroxide only to the extent of 5 grams in 100 grams. It is now found that the solubility of nitric acid in liquid nitrogen tetroxide can be increased 4—5 times if the extraction is effected at a temperature of 30°—60° C. in a closed vessel at the pressure corresponding to those temperatures. It is found that under these conditions nitrogen tetroxide does not react with water or other constituents unless organic substances which are very easily nitrated are present. The nitric acid treated should not be less than 50 per cent. strength. The layer containing pure nitric acid which separates may be cooled to 5°—10° C., when it separates again into two layers, the lower containing the greater part of the dissolved nitric acid. The upper nitrogen tetroxide layer contains only about 3 per cent. of nitric acid and may be used again. Examples are given of the treatment of nitric acid solution of 80 per cent. strength, and of waste liquor of cellulose nitration containing 30 per cent. nitric acid.

Note.—Abstracts of the following specifications, which are now accepted, appeared in The Chemical Age when they became open to inspection under the International Convention:—292,951 (E. I. Du Pont de Nemours and Co.), relating to high concentration of nitric acid, see Vol. XIX, p. 195; 294,259 (I.G. Farbenindustrie Akt.-Ges.), relating to purification of metallic salts from organic impurities, see Vol. XIX, p. 297; 294,986 (I.G. Farbenindustrie Akt.-Ges.), relating to acid wool dyestuffs, see Vol. XIX, p. 323; 298,972 (Hercules Powder Co.), relating to alkyl esters of resin acids, see Vol. XIX, p. 591; 299,330 (Consortium für Elektro-Chemische Industrie Ges.), relating to acetone, see Vol. XIX, p. 640; 300,949 (Goodyear Tire and Rubber Co.), relating to vulcanisation of rubber, see Vol. XX, p. 82; 301,093 (A. R. Frank and N. Caro), relating to hydrocyanic acid, see Vol. XX, p. 105; 295,641 (H. Sinda), relating to concentrated acetic acid, see Vol. XIX, p. 369; 296,021 (M. Polangi and S. von Bogdandy), relating to halogen derivatives of organic compounds, see Vol. XIX, p. 419; 299,332 (I.G. Farbenindustrie Akt.-Ges.), relating to azo dyestuffs, see Vol. XIX, p. 640; 300,961 (A. Messerschmidt), relating to decomposition of raw phosphates, see Vol. XX, p. 82; 305,981 (H. Terrisse and L. Dufour), relating to conversion of high boiling into low boiling hydrocarbons, see Vol. XX, p. 411; 307,484 (F. Hefti), relating to barbituric acid compounds, see Vol. XX, p. 479; 289,075 (Molybdenum Corporation of America), relating to cast iron alloys, see Vol. XIX, p. 15 (Metallurgical Section); 289,094 (Soc. of Chemical Industry in Basle), relating to dyestuffs, see Vol. XVIII, p. 615; 290,658 (Siemens und Halske Akt.-Ges.), relating to magnetic alloys, see Vol. XIX, p. 15 (Metallurgical Section); 292,904 (Newport Co.), relating to bromination products of 4 : 4¹-dimethyl-6 : 6¹-dichloro-thioindigo, see Vol. XIX, p. 195; 296,049 (Soc. Chimique de la Grande Paroisse Azote et Produits Chimiques), relating to oxygen-containing compounds, see Vol. XIX, p. 419.

International Specifications not yet Accepted

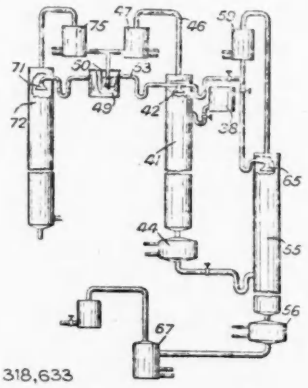
318,617-8. Oxidation of Acenaphthene. Selden Co., McCartney Street, Pittsburg, U.S.A. (Assignees of A. O. Jaeger, 9, North Grandview Avenue, Crafton, Pa., U.S.A. International Convention date, September 7, 1928.

318,617. Oxidation is effected by means of air in the presence of salts of metal acids of the fifth and sixth groups of the periodic system, particularly vanadates, vanadites and molybdates of iron, silver, manganese and aluminium. Salts of nickel, cobalt, copper, chromium, titanium, zirconium, thorium, cerium, lead, cadmium and zinc are less effective, and salts of other metals such as tungstates, chromates, uranates, tantalates, columbates, etc., may also be used. The acenaphthene substances and air, diluted with steam, are passed over the catalyst, and according to the temperature and proportion of oxygen, the product may contain acenaphthylene, acenaphthaquinone, bisacenaphthylidenedione, naphthaldehydic acid, naphthalic anhydride, hemimellitic acid, and maleic acid. Thus, pure naphthalic anhydride is obtained by vaporising acenaphthene into air in the proportion of 1:20–30 parts by weight, and passing the air over pumice coated with ferric pyrovanadate, at a temperature of 350°–400° C. Examples are given using other catalysts, to obtain acenaphthylene, etc.

318,618. Acenaphthene is vaporised into air containing steam in the proportion of 1:35 by weight, and the vapour passed at 380°–410° C. over quartz coated with vanadium pentoxide. The gases are then cooled to 140°–150° C. to precipitate naphthalic acid. A catalyst may also be made by spraying a solution containing silver vanadate, ammonia, and potassium sulphate or bisulphate on to pumice or quartz, and then calcining at 400° C. Several other examples of the preparation of vanadium catalysts are given. The products of the oxidation are those referred to in 318,617 above.

318,633. Distilling Formic Acid. Kodak, Ltd., Kodak House, Kingsway, London. (Assignees of H. T. Clarke and D. F. Othmer, Kodak Park, Rochester, N.Y., U.S.A.) International Convention date, September 8, 1928.

Dilute formic acid is mixed with *n*-propyl formate or *n*-propyl alcohol, and a mixture of water and *n*-propyl formate



318,633

is distilled off below the boiling point of water. Formic acid is fed from a vessel 38 to a fractionating column 41, and *n*-propyl formate is sprayed from a nozzle 42. Water and

n-propyl formate distil through pipe 46 to a condenser 47 and thence to a vessel 49, where the condensate separates into two layers. The upper formate layer is drawn off by a pipe 53 back to the nozzle 42. The lower water layer is separated by a partition 50, and is drawn off and sprayed by a nozzle 71 into a column 72 where it is flashed with steam to remove residual *n*-propyl formate, which passes to a condenser 75. The mixture of anhydrous formic acid and *n*-propyl formate collecting in the heater 44 passes to a column 55 and *n*-propyl formate is distilled to a condenser 59, from which it is used again. Anhydrous formic acid collects in the still bottom 56, and is fractionated again.

Specifications Accepted with Date of Application

290,613. Hydrocarbon gas or the like, Methods of treating. Empire Gas and Fuel Co. May 17, 1927.

291,409. Hydrogen, Production of. Soc. Anon. Brevetti Cicali. June 1, 1927.

293,829. Distilling and cracking oil, Method of and apparatus for. C. J. Pratt. July 13, 1927.

294,965. Chromic compounds, Manufacture of. E. Baumgartner. August 2, 1927.

295,051. Ferrous bricks for use as iron ore in metal furnaces, Manufacture of. Soc. Lorraine des Acieries de Rombas. August 6, 1927.

295,317. Silicic acid from liquids or solutions, Process for removing. A. Rosenheim. August 9, 1927. Addition to 291,435.

295,399. Cracking oil, Method and apparatus for. Standard Oil Development Co. August 11, 1927.

301,087. Thymol and menthol, Manufacture of. Schering Kahlbaum Akt.-Ges. November 24, 1927.

301,325. Benzene and derived hydrocarbons, Manufacture of—by condensation of acetylene. J. Yila Conte. November 26, 1927.

305,536. Purification of benzanthrones. Newport Co. February 6, 1928.

307,784. Alkaline or alkaline earth salts of oxalic acid and saturated monobasic fatty acids, Production of. Kemikal, Inc. March 13, 1928.

308,278. Filtration of solutions. I.G. Farbenindustrie Akt.-Ges. March 20, 1928.

321,390. Sulphur-bearing gases from ore roasting or sintering operations, Process for. National Processes, Ltd., and T. B. Gyles.

321,391. Coating metallic or non-metallic bodies with vanadium, Processes for. S. G. S. Dicker. (*Naamlooze Vennootschap Philips' Gloeilampenfabrieken.*) July 27, 1928.

321,394. Compact masses from pulverulent metallic oxides, Production of. J. Y. Johnson. (*I.G. Farbenindustrie Akt.-Ges.*) May 29, 1928.

321,399. Organic acids. Process for the production of. J. Y. Johnson. (*I.G. Farbenindustrie Akt.-Ges.*) July 6, 1928.

321,406. Elimination of mercaptans or related compounds from air, Process for . A. Carpmael. (*I.G. Farbenindustrie Akt.-Ges.*) May 31, 1928.

321,410. Evaporation purposes, Process and apparatus for. H. P. J. C. Gorgeot, and Soc. d'Exploitation d'Usines Metallurgiques. August 1, 1928.

321,425. Readily-condensable nitric oxides, Manufacture of. J. Y. Johnson. (*I.G. Farbenindustrie Akt.-Ges.*) July 7, 1928.

321,442. Borneol and iso-borneol, Production of. J. A. Tinling. August 2, 1928.

321,462. Dyes and dyeing. R. S. Barnes, J. E. G. Harris, B. Wylam, J. Thomas, and Scottish Dyes, Ltd. August 11, 1928.

321,483. Azo dyes and their application. British Dyestuffs Corporation, Ltd., and R. Brightman. August 21, 1928. Addition to 294,284.

321,494. Liquid oxidation products from hydrocarbon materials, Manufacture of. C. Arnold. (*Standard Oil Development Co.*) September 7, 1928.

321,536. Purification of gas, Apparatus for. W. Wilson. October 26, 1928.

321,566. Urea and substitution products thereof, Manufacture of. J. Y. Johnson. (*I.G. Farbenindustrie Akt.-Ges.*) November 19, 1928.

321,580. Salts of the urea of *m*-amino-benzoyl-*m*-amino-*p*-toluyl-l-naphthyl-amine-4:6:8-trisulphonic acid, Manufacture of. G. M. Dyson and A. Renshaw. December 5, 1928.

321,585. Vat dyestuffs, of the pyrazolanthrone series, Manufacture of. J. Y. Johnson. (*I.G. Farbenindustrie Akt.-Ges.*) December 15, 1928.

Applications for Patents

[*In the case of applications for patents under the International Convention, the priority date (that is, the original application date abroad which the applicant desires shall be accorded to the patent) is given in brackets, with the name of the country of origin. Specifications of such applications are open to inspection at the Patent Office on the anniversary of the date given in brackets, whether or not they have been accepted.*]

Barrett Co. Distillation of tar. 35,703. November 21. (United States, November 30, 1928.)

Boots Pure Drug Co., Ltd., Easson, A. P. T., and Pyman, F. L. Manufacture of amidines. 35,805. November 22.

British Celanese, Ltd. Manufacture of artificial materials. 35,199. November 18.

—— Artificial effect materials. 35,201. November 18.

—— Manufacture, etc., of synthetic products. 35,202, 35,203, 35,204. November 18. (United States, November 17, 1928.)

—— Manufacture of synthetic products. 35,933. November 23. (United States, November 26, 1928.)

Brotherhood, Ltd., P., Carbon Dioxide Co., Ltd., and Dunkerley, H. M. Production of carbon dioxide. 35,362. November 19.

Buchner, M. Production of aluminium sulphate. 35,498. November 20. (Germany, November 24, 1928.)

Carpmael, A. and I.G. Farbenindustrie Akt.-Ges. Manufacture of disazo-dyestuffs insoluble in water. 35,257. November 18.

—— Manufacture of acid disazo dyestuffs. 35,345. November 19.

—— Manufacture of metallic compounds of the thiazole series. 35,692. November 21.

—— Manufacture of product containing vitamine B. 35,826. November 22.

Chemische Fabrik vorm. Sandoz. Manufacture of antimony compounds. 35,968. November 23. (Germany, November 30, 1928.)

Coley, H. E. Production of tin from ores. 35,247. November 18.

—— Extraction of volatile metals from ores, etc. 35,626. November 21.

—— Reduction of ores, etc. 35,801, 35,803. November 22.

—— Separation of metals from ores, etc. 35,802. November 22.

—— Manufacture of zinc oxide. 35,804. November 22.

Du Pont de Nemours and Co., E. I., and Triggs, W. W. Softeners for plastic materials. 35,617. November 21.

—— Coating, etc., material. 35,618. November 21.

Firing, L., and Monk, R. H. Production of titanium pigments. 35,156. November 18.

Groves, W. W., and Soc. of Chemical Industry in Basle. Manufacture of cellulose esters. 35,358. November 19.

Hydro-Nitro Soc. Anon. Production of materials containing phosphorus and nitrogen. 35,384. November 19. (Switzerland, December 1, 1928.)

I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of diolefines. 35,177. November 18.

—— Production of hydrogen, etc. 35,178. November 18.

—— Manufacture of chloro derivatives of the anthraquinone-acridone series. 35,488. November 20.

—— Fractional distillation of mixtures containing hydrocarbons of the butadiene series. 35,489. November 20.

I.G. Farbenindustrie Akt.-Ges. Manufacture of hormones. 35,262. November 18. (Germany, April 26, 1928.)

—— Production of chemically pure phosphoric acid. 35,273. November 18. (Germany, February 20.)

—— Manufacture of aromatic N-dialkylamino-alkylamino-aldehydes, etc. 35,693. November 21.

Imperial Chemical Industries, Ltd. Producing acetylene. 35,300. November 19.

International Industrial and Chemical Co., Ltd. Manufacture of alkali carbonates. 35,221. November 18. (France, November 21, 1928.)

—— Preparation of barium carbide, etc. 35,222. November 18. (France, November 21, 1928.)

Laing, B., and Nielsen, H. Distillation of solid carbonaceous materials, etc. 35,812. November 22.

Manlove, Alliott and Co., Ltd. Hydro-extractors, etc. 35,666. November 21.

Shaw, H. S. Hele-. Filtration. 35,700. November 21.

Soc. Chimique de la Grande-Paroisse Azote et Produits Chimiques. Fertilisers. 35,336. November 19. (France, January 11.)

—— Fertilisers. 35,854. November 22. (France, November 23, 1928.)

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£19 per ton.

ACID BORIC, COMMERCIAL.—Crystal, £20 per ton; powder, £21 per ton; extra fine powder, £23 per ton. Packed in 2 cwt. bags carriage paid any station in Great Britain.

ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength and locality.

ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works according to district and quality.

ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.

BISULPHITE OF LIME.—£7 10s. per ton, f.o.r. London, packages free.

BLEACHING POWDER.—Spot, £9 10s. per ton d/d; Contract, £8 10s. per ton d/d, 4-ton lots.

BORAX, COMMERCIAL.—Crystals, £19 10s. to £20 per ton; granulated, £12 10s. per ton; powder, £14 per ton. (Packed in 1 cwt. bags carriage paid any station in Great Britain.)

CALCIUM CHLORIDE (SOLID).—£5 to £5 5s. per ton d/d carr. paid.

COPPER SULPHATE.—£25 to £25 10s. per ton.

METHYLATED SPIRIT 61 O.P.—Industrial, 1s. 3d. to 1s. 8d. per gall. pyridinised industrial, 1s. 5d. to 1s. 10d. per gall.; mineralised 2s. 4d. to 2s. 8d. per gall.; 64 O.P., 1d. extra in all cases.

NICKEL SULPHATE.—£38 per ton d/d.

NICKEL AMMONIA SULPHATE.—£38 per ton d/d.

POTASH CAUSTIC.—£30 to £33 per ton.

POTASSIUM BICHROMATE.—4½d. per lb.

POTASSIUM CHLORATE.—3⅞d. per lb., ex-wharf, London, in cwt. kegs.

SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.

SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.

SODA CAUSTIC, SOLID.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.

SODA CRYSTALS.—£5 to £5 5s. per ton, ex railway depots or ports.

SODIUM ACETATE 97/98%.—£21 per ton.

SODIUM BICARBONATE.—£10 10s. per ton, carr. paid.

SODIUM BICHROMATE.—3⅝d. per lb.

SODIUM BISULPHITE POWDER, 60/62%.—£17 10s. per ton delivered for home market, 1-cwt. drums included; £15 10s. f.o.r. London.

SODIUM CHLORATE.—2¾d. per lb.

SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.

SODIUM PHOSPHATE.—£14 per ton, f.o.b. London, casks free.

SODIUM SULPHATE (GLAUBER SALTS).—£3 12s. 6d. per ton.

SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.

SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.

SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.b. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—7d. to 10d. per lb. Crude 60's, 2s. 5½d. to 2s. 6d. per gall.

ACID CRESYLIC 99/100.—2s. 2d. to 2s. 7d. per gall. Pure, 5s. 6d. per gall. 97/99.—2s. 1d. to 2s. 2d. per gall. Pale, 95%, 1s. 9d. to 1s. 10d. per gall. 98%, 2s. 2d. to 2s. 5d. Dark, 1s. 6d. to 2s. 2d. Refined, 2s. 7d. to 2s. 10d. per gall.

ANTHRACENE.—A quality, 2d. to 2½d. per unit. 40%, £4 10s. per ton.

ANTHRACENE OIL, STRAINED, 1080/1090.—4¾d. to 5½d. per gall. 1100, 5½d. to 6d. per gall.; 1110, 6d. to 6½d. per gall. Unstrained (Prices only nominal).

BENZOLE.—Prices at works: Crude, 10d. to 11d. per gall.; Standard Motor, 1s. 5d. to 1s. 6d. per gall.; 90%, 1s. 7d. to 1s. 8d. per gall; Pure, 1s. 10d. to 1s. 11d. per gall.

TOLUOLE.—90%, 1s. 9d. to 2s. 1d. per gall. Firm. Pure, 1s. 11d. to 2s. 4d. per gall.

XYLOL.—1s. 5d. to 1s. 10d. per gall. Pure, 1s. 8d. to 2s. 1d. per gall.

CREOSOTE.—Cresylic, 20/24%, 6¾d. to 7d. per gall.; Heavy, 6¼d to 6½d. per gall. Middle oil, 4½d. to 5d. per gall. Standard specification, 3d. to 4d. per gall. Light gravity, 2d. to 2½d. per gall. ex works. Salty, 7½d. per gall.

NAPHTHA.—Crude, 8½d. to 8¾d. per gall. Solvent, 90/160, 1s. 3d. to 1s. 3½d. per gall. Solvent, 95/160, 1s. 4d. to 1s. 5d. per gall. Solvent 90/190, 1s. to 1s. 3d. per gall.

NAPHTHALENE, CRUDE.—Drained Creosote Salts, £4 10s. to £5 per ton. Whizzed, £5 per ton. Hot pressed, £8 10s. per ton.

NAPHTHALENE.—Crystals, £12 5s. per ton. Purified Crystals, £14 10s. per ton. Quiet Flaked, £14 to £15 per ton, according to districts.

PITCH.—Medium soft, 47s. 6d. per ton, f.o.b., according to district. Nominal.

PYRIDINE.—90/140, 3s. 9d. to 4s. per gall. 90/160, 3s. 6d. to 3s. 9d. per gall. 90/180, 1s. 9d. to 2s. 3d. per gall. Heavy, prices only nominal.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:

ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.

ACID ANTHRANILIC.—6s. per lb. 100%.

ACID BENZOIC.—1s. 8½d. per lb.

ACID GAMMA.—4s. 6d. per lb.

ACID H.—3s. per lb.

ACID NAPHTHIONIC.—1s. 6d. per lb.

ACID NEVILLE AND WINTHER.—4s. 9d. per lb.

ACID SULPHANILIC.—8½d. per lb.

ANILINE OIL.—8d. per lb. naked at works.

ANILINE SALTS.—8d. per lb. naked at works.

BENZALDEHYDE.—2s. 3d. per lb.

BENZIDINE BASE.—3s. 3d. per lb. 100% basis d/d.

BENZOIC ACID.—1s. 8½d. per lb.

o-CRESOL 29/31° C.—£3 1s. 10d. per cwt., in 1 ton lots.

m-CRESOL 98/100%.—2s. 9d. per lb, in ton lots d/d.

p-CRESOL 32/34° C.—2s. per lb., in ton lots d/d.

DICHLORANILINE.—1s. 10d. per lb.

DIMETHYLANILINE.—1s. 11d. per lb.

DINITROBENZENE.—8d. per lb. naked at works. £75 per ton.

DINITROCHLORBENZENE.—£84 per ton d/d.

DINITROTOLUENE.—48/50° C. 7½d. per lb. naked at works. 66/68° C, 9d. per lb. naked at works.

DIPHENYLAMINE.—2s. 10d. per lb. d/d.

a-NAPHTHOL.—2s. per lb. d/d.

B-NAPHTHOL.—10d. per lb. d/d.

a-NAPHTHYLAMINE.—1s. 3d. per lb.

B-NAPHTHYLAMINE.—3s. per lb.

o-NITRANILINE.—5s. 9d. per lb.

m-NITRANILINE.—3s. per lb. d/d.

p-NITRANILINE.—1s. 8d. per lb.

NITROBENZENE.—6d. per lb. naked at works.

NITRONAPHTHALENE.—1s. 3d. per lb.

R. SALT.—2s. 2d. per lb.

SODIUM NAPHTHIONATE.—1s. 8½d. per lb. 100% basis d/d.

o-TOLUIDINE.—8d. per lb.

p-TOLUIDINE.—1s. 9d. per lb. naked at works.

m-XYLIDINE ACETATE.—2s. 6d. per lb. 100%.

N. W. ACID.—4s. 9d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £9 15s. to £10 5s. per ton. Grey, £16 10s. to £17 10s. per ton. Liquor, 9d. per gall.

ACETONE.—£78 per ton.

CHARCOAL.—£6 to £8 10s. per ton, according to grade and locality.

IRON LIQUOR.—1s. 3d. per gall, 32° Tw. 1s. per gall. 24° Tw.

RED LIQUOR.—9d. to 10½d. per gall. 16° Tw.

WOOD CRESOTE.—1s. 9d. per gall. Unrefined.

WOOD NAPHTHA, MISCIBLE.—3s. 8d. to 3s. 11d. per gall. Solvent, 4s. to 4s. 3d. per gall.

WOOD TAR.—£3 10s. to £4 10s. per ton.

BROWN SUGAR OF LEAD.—£38 per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 3d. per lb. according to quality; Crimson, 1s. 4d. to 1s. 6d. per lb., according to quality.

ARSENIC SULPHIDE, YELLOW.—1s. 10d. to 2s. per lb.

BARYTES.—£5 10s. to £7 per ton, according to quality.

CADMIUM SULPHIDE.—5s. to 6s. per lb.

CARBON BISULPHIDE.—£25 to £27 10s. per ton, according to quantity

CARBON BLACK.—5½d. per lb., ex wharf.

CARBON TETRACHLORIDE.—£40 to £50 per ton, according to quantity, drums extra.

CHROMIUM OXIDE, GREEN.—1s. 2d. per lb.

DIPHENYLGUANIDINE.—3s. 9d. per lb.

INDIARUBBER SUBSTITUTES, WHITE AND DARK.—4½d. to 5½d. per lb.

LAMP BLACK.—£30 per ton, barrels free.

LEAD HYPOSULPHITE.—9d. per lb.

LITHOPONE, 30%.—£20 to £22 per ton.

MINERAL RUBBER "RUBPRON."—£13 12s. 6d. per ton, f.o.r. London

SULPHUR.—£10 to £13 per ton, according to quality.

SULPHUR CHLORIDE.—4d. to 7d. per lb., carboys extra

SULPHUR PRECIP. B. P.—£55 to £60 per ton.

THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb., carriage paid.

THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.

VERMILION, PALE OR DEEP.—6s. 6d. to 6s. 9d. per lb.

ZINC SULPHIDE.—8d. to 11d. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, PURE, 80%.—£37 per ton ex wharf London, barrels free.

ACID, ACETYL SALICYLIC.—2s. 9d. to 2s. 11d. per lb., according to quantity.

ACID, BENZOIC, B.P.—2s. to 3s. 3d. per lb., according to quantity. Solely ex Gum, 1s. 6d. per oz.; 50-oz. lots, 1s. 3d. per oz.

ACID, BORIC B.P.—Crystal, £32 per ton; powder, £36 per ton; extra fine powder, £38 per ton. Packed in 2-cwt. bags carriage paid any station in Great Britain.

ACID, CAMPHORIC.—19s. to 21s. per lb.

ACID, CITRIC.—1s. 11½d. to 2s. per lb., less 5%.

ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.

ACID, MOLYBDIC.—5s. 3d. per lb. in ¼ cwt. lots. Packages extra. Special prices for quantities and contracts.

ACID, PYROGALLIC, CRYSTALS.—7s. 3d. per lb. Resublimed, 8s. 3d.

ACID, SALICYLIC, B.P. PULV.—1s. 5d. to 1s. 7d. per lb. Technical.—1s. to 1s. 2d. per lb.

ACID, TANNIC B.P.—2s. 8d. to 2s. 10d. per lb.

ACID, TARTARIC.—1s. 4½d. per lb., less 5%.

ACETANILIDE.—1s. 5d. to 1s. 8d. per lb. for quantities.

AMIDOL.—7s. 6d. to 9s. per lb., d/d.

AMIDOPYRIN.—7s. 9d. to 8s. per lb.

AMMONIUM BENZOATE.—3s. 3d. to 3s. 9d. per lb., according to quantity. 18s. per lb. ex Gum.

AMMONIUM CARBONATE B.P.—£36 per ton. Powder, £39 per ton in 5 cwt. casks. Resublimated, 1s. per lb.

AMMONIUM MOLYBDATE.—4s. 9d. per lb. in ¼ cwt. lots. Packages extra. Special prices for quantities and contracts.

ATROPHINE SULPHATE.—9s. per oz.

BARBITONE —5s. 9d. to 6s. per lb.

BENZONAPHTHOL.—3s. to 3s. 3d. per lb. spot.

BISMUTH CARBONATE.—8s. 9d. per lb.

BISMUTH CITRATE.—8s. 3d. per lb.

BISMUTH SALICYLATE.—8s. 3d. per lb.

BISMUTH SUBNITRATE.—7s. 6d. per lb.

BISMUTH NITRATE.—Cryst. 5s. 3d. per lb.

BISMUTH OXIDE.—11s. 3d. per lb.

BISMUTH SUBCHLORIDE.—10s. 3d. per lb.

BISMUTH SUBGALLATE.—7s. 3d. per lb. Extra and reduced prices for smaller and larger quantities of all bismuth salts respectively.

BISMUTHI ET AMMON LIQUOR.—Cit. B.P. in W. Qts. 1s. o½d. per lb.; 12 W. Qts. 11½d. per lb.; 36 W Qts. 11d. per lb.

BORAX B.P.—Crystal, £20 per ton; powder, £21 per ton. Packed in 1- or 2-cwt. bags carriage paid any station in Great Britain.

BROMIDES.—Ammonium, 1s. 11½d. per lb.; potassium, 1s. 8½d. per lb.; granular, 1s. 7¾d. per lb.; sodium, 1s. 10½d. per lb. Prices for 1 cwt. lots.

CALCIUM LACTATE.—B.P., 1s. 2d. to 1s. 3d per lb., in 1-cwt. lots.

CAMPHOR.—Refined flowers, 3s. 3d. to 3s. 4d. per lb., according to quantity; also special contract prices.

CHLORAL HYDRATE.—3s. 1d. to 3s. 4d. per lb.

CHLOROFORM.—2s. 4½d. to 2s. 7½d. per lb., according to quantity.

CREOSOTE CARBONATE.—6s. per lb.

ETHERS.—S.G. ·730—11d. to 1s. per lb., according to quantity other gravities at proportionate prices.

FORMALDEHYDE, 40%.—37s. per cwt., in barrels, ex wharf.

GUAIACOL CARBONATE.—4s. 6d. to 4s. 9d. per lb.

HEXAMINE.—2s. 3d. to 2s. 6d. per lb.

HOMATROPINE HYDROBROMIDE.—30s. per oz.

HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.

HYDROGEN PEROXIDE (12 VOLS.).—1s. 4d. per gallon, f.o.r. makers' works, naked. Winchesters, 2s. 11d. per gall. B.P., 10 vols., 2s. to 2s. 3d. per gall.; 20 vols., 4s. per gall.

HYDROQUINONE.—3s. 9d. to 4s. per lb., in cwt. lots.

HYPOPHOSPHITES.—Calcium, 2s. 5d. per lb.; potassium, 2s. 8½d. per lb.; sodium, 2s. 7½d. per lb., in 1 cwt. lots, assorted.

IRON AMMONIUM CITRATE.—B.P., 2s. 8d. to 2s. 11d. per lb. Green, 3s. 1d. to 3s. 4d. per lb. U.S.P., 2s. 9d. to 3s. per lb.

IRON PERCHLORIDE.—18s. to 20s. per cwt., according to quantity.

IRON QUININE CITRATE.—B.P., 8¾d. to 9½d. per oz., according to quantity.

MAGNESIUM CARBONATE.—Light commercial, £31 per ton net.

MAGNESIUM OXIDE.—Light commercial, £62 10s. per ton, less 2½%; Heavy commercial, £21 per ton, less 2½%; in quantity lower; Heavy Pure, 2s. to 2s. 3d. per lb.

MENTHOL.—A.B.R. recrystallised B.P., 18s. 6d. per lb. net; Synthetic, 9s. 6d. to 10s. 6d. per lb.; Synthetic detached crystals 9s. 6d. to 12s. 6d. per lb., according to quantity; Liquid (95%), 9s. per lb.

MERCURIALS B.P.—Up to 1 cwt. lots, Red Oxide, crystals, 8s. 4d. to 8s. 5d. per lb., levig., 7s. 10d. to 7s. 11d. per lb.; Corrosive Sublimate, Lump, 6s. 7d. to 6s. 8d. per lb., Powder, 6s. to 6s. 1d. per lb.; White Precipitate, Lump, 6s. 9d. to 6s. 10d. per lb., Powder, 6s. 10d. to 6s. 11d. per lb., Extra Fine, 6s. 11d. to 7s. per lb.; Calomel, 7s. 2d. to 7s. 3d. per lb.; Yellow Oxide, 7s. 8d. to 7s. 9d. per lb.; Persulph, B.P.C., 6s. 11d. to 7s. per lb.; Sulph. nig., 6s. 8d. to 6s. 9d. per lb. Special prices for larger quantities.

METHYL SALICYLATE.—1s. 6d. to 1s. 8d. per lb.

METHYL SULPHONAL.—18s. 6d. to 20s. per lb.

METOL.—9s. to 11s. 6d. per lb. British make.

PARAFORMALDEHYDE.—1s. 9d. per lb. for 100% powder.

PARALDEHYDE.—1s. 4d. per lb.

PHENACETIN.—3s. 2½d. to 3s. 9d. per lb.

PHENAZONE.—5s. 11d. to 6s. 1½d. per lb.

PHENOLPHTHALEIN.—5s. 11d. to 6s. 1½d. per lb.

POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—104s. per cwt., less 2½ per cent.

POTASSIUM CITRATE.—B.P.C., 2s. 7d. per lb. in 1 cwt. lots.

POTASSIUM FERRICYANIDE.—1s. 9d. per lb., in cwt. lots.

POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb., according to quantity.

POTASSIUM METABISULPHITE.—6d. per lb., 1-cwt. kegs included f.o.r. London.

POTASSIUM PERMANGANATE.—B.P. crystals, 5½d. per lb., spot.

QUININE SULPHATE.—1s. 8d. to 1s. 9d. per oz., bulk in 100 oz. tins.

RESORCIN.—2s. 10d. to 3s. per lb., spot.

SACCHARIN.—43s. 6d. per lb.

SALOL.—2s. 3d. to 2s. 6d. per lb.

SODIUM BENZOATE, B.P.—1s. 8d. to 1s. 11d. per lb.

SODIUM CITRATE, B.P.C., 1911.—2s. 4d. per lb., B.P.C. 1923—2s. 7d. per lb. Prices for 1 cwt. lots. U.S.P., 2s. 6d. to 2s. 9d. per lb., according to quantity.

SODIUM FERROCYANIDE.—4d. per lb., carriage paid.

SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£15 per ton, d/d consignee's station in 1-cwt. kegs.

SODIUM NITROPRUSSIDE.—16s. per lb.

SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—100s. per cwt. Crystals, 5s. per cwt. extra.

SODIUM SALICYLATE.—Powder, 2s. 2d. to 2s. 4d. per lb. Crystal, 2s. 3d. to 2s. 5d. per lb.

SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 1d. per lb.

SODIUM SULPHITE, ANHYDROUS.—£27 10s. to £29 10s. per ton, according to quantity. Delivered U.K.

SULPHONAL.—9s. 6d. to 10s. per lb.

TARTAR EMETIC, B.P.—Crystal or powder, 2s. 1d. to 2s. 3d. per lb

THYMOL.—Puriss., 9s. 1d. to 9s. 4d. per lb., according to quantity Firmer. Natural, 12s. per lb.

Perfumery Chemicals

ACETOPHENONE.—7s. per lb.

AUBEPINE (EX ANETHOL).—12s. per lb.

AMYL ACETATE.—2s. 6d. per lb.

AMYL BUTYRATE.—5s. per lb.

AMYL CINNAMIC ALDEHYDE.—15s. per lb.

AMYL SALICYLATE.—2s. 9d. per lb.

ANETHOL (M.P. 21/22° C.).—6s. per lb.

BENZALDEHYDE FREE FROM CHLORINE.—2s. 6d. per lb.

BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—2s. per lb.

BENZYL ALCOHOL FREE FROM CHLORINE.—2s. per lb.

BENZYL BENZOATE.—2s. 3d. per lb.

CINNAMIC ALDEHYDE NATURAL.—13s. 3d. per lb.

COUMARIN.—8s. 9d. per lb.

CITRONELLOL.—9s. per lb.

CITRAL.—8s. per lb.

ETHYL CINNAMATE.—6s. 6d. per lb.

ETHYL PHTHALATE.—2s. 9d. per lb.

EUGENOL.—11s. 3d. per lb.

GERANIOL (PALMAROSA).—19s. per lb.

GERANIOL.—7s. 6d. to 10s. per lb.

HELIOTROPINE.—6s. 9d. per lb.

ISO EUGENOL.—12s. 6d per lb.

LINALOL.—Ex Bois de Rose, 12s. per lb. Ex Shui Oil, 10s. per lb.

LINALYL ACETATE.—Ex Bois de Rose, 15s. per lb. Ex Shui Oil, 12s. per lb.

PHENYL ETHYL ACETATE.—11s. per lb.

PHENYL ETHYL ALCOHOL.—9s. 6d. per lb.

RHODINOL.—48s. per lb.

SAFROL.—2s. 3d. per lb.

TERPINEOL.—1s. 6d. per lb.

VANILLIN, EX CLOVE OIL.—14s. to 15s. per lb. Ex Guaiacol, 12s. 9d. to 14s. per lb.

Essential Oils

ALMOND OIL.—Foreign S.P.A., 10s. per lb.

ANISE OIL.—3s. 10d. per lb.

BERGAMOT OIL.—14s. 9d. per lb.

BOURBON GERANIUM OIL.—18s. 6d. per lb.

CAMPHOR OIL, WHITE.—16os. per lb.

CANANGA OIL, JAVA.—11s. 6d. per lb.

CASSIA OIL, 80/85%.—5s. 6d. per lb.

CINNAMON OIL LEAF.—8s. 6d. per oz.

CITRONELLA OIL.—Java, 3s. 4d. per lb., c.i.f. U.K. port.

CLOVE OIL (90/92%).—8s. per lb.

EUCALYPTUS OIL, AUSTRALIAN, B.P. 70/75%.—1s. 10d. per lb.

LAVENDER OIL.—Mont Blanc, 38/40%, 13s. 6d. per lb.

LEMON OIL.—11s. 6d. per lb.

LEMONGRASS OIL.—4s. per lb.

ORANGE OIL, SWEET.—14s. 6d. per lb.

PEPPERMINT OIL.—English, 70s. per lb.; Wayne County, 15s. 6d. per lb.; Japanese, 5s. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.*

London, November 28, 1929.

THERE has been a steady demand for various chemicals during the current week, and prices continue steady and firm. Export business is also quite good.

General Chemicals

ACETONE.—Unchanged at £76 10s. to £85 per ton, according to quantity, and in steady demand.

ACETIC ACID is in regular demand and unchanged at £36 10s. for 80% technical, with the usual £1 per ton extra for 80% edible.

CITRIC ACID continues slow at about 2s. 1½d. per lb., less 5%.

ACID LACTIC is steady at £43 per ton for the 50% by weight.

ACID OXALIC.—The increased demand continues, with price firm at £30 7s. 6d. to £32 per ton, according to quantity.

TARTARIC ACID is unchanged at 1s. 4½d. per lb. to 1s. 5d. per lb., less 5%, with a little better demand.

ALUMINA SULPHATE is firm at £8 to £8 5s. per ton for the 17–18% iron free quality.

ARSENIC is firm at £16 17s. 6d. per ton, free on rails mines.

BORAX is in regular demand at £13 per ton.

CREAM OF TARTAR is firm at £104 to £106 per ton for 99–100% B.P quality, with a steady inquiry.

COPPER SULPHATE firm at £28 per ton, less 5%.

FORMALDEHYDE.—Steady at £36 per ton, with considerable demand.

LEAD ACETATE.—Unchanged at £44 for white and £43 per ton for brown, and in steady request.

LEAD NITRATE is in rather more demand at £33 15s. per ton.

LIME ACETATE is unchanged.

LITHOPONE.—Unchanged at £19 15s. to £23, according to quality, with steady demand.

POTASSIUM CARBONATE.—Firm at £27 per ton for 96–98% best quality.

CHLORATE OF POTASH is in active demand at £30 per ton.

PERMANGANATE OF POTASH is very firm at 5½d. to 5¾d. per lb. for B.P. quality needle crystals, and is in steady request.

SODIUM ACETATE.—In good demand at £22 to £22 10s. per ton.

SODIUM BICHROMATE is unchanged and firm at 3⅝d. per lb., with rebates for contracts, and in steady demand.

SODIUM HYPOSULPHITE is unchanged at £14 10s. to £15 per ton for photographic quality; commercial, £8 10s. to £9 per ton, and in steady request.

SODA NITRITE is unchanged at £20 per ton, and in regular demand.

SODIUM PHOSPHATE.—The improved demand continues. Dibasic at £12 and tribasic at £17 10s. per ton, with market firm.

SODIUM PRUSSIATE is firm at 4⅜d. to 5¼d. per lb.

SODIUM SULPHIDE is extremely firm at the advanced prices, and in steady request.

TARTAR EMETIC.—Steady at 11d. per lb., and in good demand.

ZINC SULPHATE is unchanged at £13 10s. per ton, with a fair demand.

Coal Tar Products

There is little change to report in the prices of coal tar products from last week. Although there seems to be a slight depression in the market at the moment, prices still remain fairly firm, with the exception of creosote oil and naphthalenes.

MOTOR BENZOL is firm, at about 1s. 5½d. to 1s. 6d. per gallon, f.o.r.

SOLVENT NAPHTHA remains at about 1s. 2½d. to 1s. 3d. per gallon, f.o.r.

HEAVY NAPHTHA is unchanged, at about 1s. 1d. per gallon, f.o.r.

CREOSOTE OIL is quoted at 3d. to 3½d. per gallon on rails in the North, and at 4d. to 4½d. per gallon in London.

NAPHTHALENES.—The firelighter quality is quoted at £4 per ton, the 74/76 quality at about £4 10s. per ton, and the 76/78 quality at about £5 per ton.

PITCH.—The market remains steady at 47s. 6d. per ton, f.o.b. East Coast port.

Nitrogen Products

Sulphate of Ammonia.—The demand for sulphate of ammonia continues quiet, and the price has receded to £8 10s. to £8 12s. 6d. per ton, f.o.b. U.K. port, in single bags for neutral quality basis 20·6 per cent. nitrogen.

Home.—There is little interest in the home market for prompt delivery. Buyers are eagerly awaiting announcement of prices for the spring months.

Nitrate of Soda.—The nitrate market continues very quiet. In view of the increasing stocks of the product, buyers are tending to hold off.

Latest Oil Prices

LONDON, November 27.—LINSEED OIL was firm, and 7s. 6d. to 10s. per ton higher. Spot, ex mill, £44 5s.; December, £41 17s. 6d.; January to April, £39 17s. 6d.; May to August, £37 7s. 6d. RAPE OIL was slow. Crude extracted, £42 10s.; technical refined, £44, naked, ex wharf. COTTON OIL was dull. Egyptian crude, £30; refined common edible, £35; and deodorised, £37, naked, ex mill. TURPENTINE was dull, and 3d. per cwt. lower. American spot and November to December, 41s. 6d.; and January to April, 42s. 6d.

HULL.—LINSEED OIL.—Spot and November, £42 7s. 6d.; December, £42 5s.; January to April, £41 2s. 6d.; May to August, £38 7s. 6d. per ton, naked. COTTON OIL.—Egyptian crude spot, £27 10s.; edible refined spot, £31 10s.; technical spot, £31; deodorised spot, £33 10s. per ton, naked. PALM KERNEL OIL.—Crude 5½ per cent. spot, £32 10s. per ton, naked. GROUNDNUT OIL.—Crushed/extracted spot, £35 10s.; deodorised spot, £39 10s. per ton. SOYA OIL.—Extracted/crushed spot, £32 10s.; deodorised spot, £36 per ton. RAPE OIL.—Crushed/extracted spot, £41 10s.; refined spot, £43 10s. per ton. TURPENTINE.—Spot, 44s. per cwt., net cash terms, ex mill. CASTOR OIL and COD OIL unchanged.

South Wales By-Products

SOUTH WALES by-product activities remain quiet. The demand for pitch has fallen off slightly, but values are unchanged at 49s. to 50s. per ton, delivered. Creosote has weakened, with quotations unchanged at 3d. to 4¼d. per gallon. Solvent and heavy naphthas are slightly better, solvent being quoted 1s. 2½d. to 1s. 4½d. per gallon, and heavy from 11d. to 1s. 1d. per gallon. Road tar is in better demand, but quotations are steady at 11s. to 14s. per 40-gallon barrel. Sulphate of ammonia has no call. Refined tars have a steady, but moderate, demand, quotations for both gasworks and coke-oven tar being unchanged. Motor benzol is in slightly better request at 1s. 3½d. to 1s. 5d. per gallon. Patent fuel and coke exports are still expanding, but are not yet satisfactory. Patent fuel quotations are :—Ex-ship, Cardiff, 22s. to 22s. 6d.; ex-ship Swansea and Newport, 20s. 6d. to 21s. per ton.

Precautions Against Freezing of Radiator Contents

PRACTICALLY every winter a number of motor vehicles suffer damage by the action of frost, and as a result of the exceptionally severe weather last winter the inconvenience caused to motorists owing to their vehicles being out of commission through frost damage was very considerable. In order to assist motor owners, the Royal Insurance Co., Ltd. has prepared a card showing some simple precautions for avoiding damage to vehicles by frost. The card gives details of suitable anti-freezing mixtures, consisting of water and glycerine or motor spirit, the quantities of each constituent required in cooling systems of various capacities being shown. Various hints for the protection of the cooling system are also given. Copies of this card will be forwarded to any readers of THE CHEMICAL AGE who cares to apply to the company's head offices, at 1, North John Street, Liverpool, or 24-28, Lombard Street, London, or to any of its branches.

Rayon Cellulose from Sugar Cane

AT the request of the manufacturer, a sample of alpha-cellulose made from sugar cane has been tested by the United States Bureau of Standards for its suitability for use in the rayon industry. Alpha-, beta- and gamma-cellulose, copper number, KOH solubility, ash and iron determinations were made. From the results of these tests the pulp appears to be quite satisfactory for rayon use, as far as the properties tested are concerned. The alpha-cellulose content was high and the copper number quite low, indicating a high degree of purification. The beta-cellulose content and the portion soluble in caustic potash further bear this out. The beta-cellulose made up the difference between the alpha-cellulose content and the total fibre, and the portion soluble in KOH was less than 3 per cent. The ash content was very low. Some iron was present, but only a very slight trace.

DIACETONE ALCOHOL

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Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

Glasgow, November 27, 1929.

SINCE our last report the heavy chemical market shows little or no change, a good number of inquiries being received for both home and export business. Many of the inquiries now being received are for contracts covering next year's requirements. Prices on the whole are practically on the same level, and there is no sign of any advance in the near future.

Industrial Chemicals

ACETONE, B.G.S.—£76 10s. to £85 per ton, ex wharf, according to quantity. Inquiry remains satisfactory.

ACID ACETIC.—This material is still scarce for immediate supply, but prices remain unchanged as follows: 98/100% glacial, £56 to £67 per ton, according to quality and packing, c.i.f. U.K. ports; 80% pure, £37 10s. per ton, ex wharf; 80% technical, £37 10s. per ton, ex wharf.

ACID BORIC.—Crystals, granulated or small flakes, £30 per ton. Powder, £32 per ton, packed in bags, carriage paid U.K. stations. There are a few fairly cheap offers made from the Continent.

ACID CARBOLIC, ICE CRYSTALS.—Prompt delivery difficult to obtain and prices quoted for early delivery round about 8d. per lb., delivered or f.o.b. U.K. ports.

ACID CITRIC, B.P. CRYSTALS.—Quoted 2s. 2d. per lb., less 5%, ex store, prompt delivery. Rather cheaper offers for early delivery from the Continent.

ACID HYDROCHLORIC.—Usual steady demand. Arsenical quality, 4s. per carboy; dearsenicated quality, 5s. 6d. per carboy, ex works, full wagon loads.

ACID NITRIC, 80° QUALITY.—£24 10s. per ton, ex station, full truck loads.

ACID OXALIC, 98/100%.—On offer at about 3¼d. per lb., ex store. Offered from the Continent at 3⅛d. per lb., ex wharf.

ACID SULPHURIC.—£2 15s. per ton ex works for 144° quality; £5 15s. per ton for 168°. Dearsenicated quality, 20s. per ton extra.

ACID TARTARIC, B.P. CRYSTALS.—Quoted 1s. 5d. per lb., less 5%, ex wharf. On offer for prompt delivery from the Continent at 1s. 4½d. per lb., less 5%, ex wharf.

ALUMINA SULPHATE.—Quoted at round about £7 10s. per ton, ex store.

ALUM, LUMP POTASH.—Now quoted £8 7s. 6d. per ton, c.i.f. U.K. ports. Crystal meal about 2s. 6d. per ton less.

AMMONIA, ANHYDROUS.—Quoted 7½d. per lb., carriage paid. Containers extra and returnable.

AMMONIA CARBONATE.—Lump quality quoted £36 per ton, powdered £38 per ton, packed in 5 cwt. casks, delivered U.K. stations or f.o.b. U.K. ports.

AMMONIA LIQUID, 880°.—Unchanged at about 2½d. to 3d. per lb., delivered according to quantity.

AMMONIA MURIATE.—Grey galvanisers' crystals of British manufacture quoted £21 to £22 per ton, ex station. Fine white crystals offered from the Continent at about £17 5s. per ton, c.i.f. U.K. ports.

ANTIMONY OXIDE.—Spot material quoted £37 per ton, ex wharf. On offer for prompt shipment from China at £34 per ton, c.i.f. U.K. ports.

ARSENIC, WHITE POWDERED.—Now quoted £18 per ton, ex wharf, prompt despatch from mines. Spot material still on offer at £19 15s. per ton, ex store.

BARIUM CHLORIDE.—In good demand and price about £11 per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—British manufacturers' contract price to consumers unchanged at £6 12s. 6d. per ton, delivered in minimum 4-ton lots. Continental now offered at about the same figure.

CALCIUM CHLORIDE.—Remains unchanged. British manufacturers' price £4 5s. per ton to £4 15s. per ton, according to quantity and point of delivery. Continental material on offer at £3 12s. 6d. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—Unchanged at about £3 10s. per ton, f.o.r. works, or £4 12s. 6d. per ton f.o.b. U.K. ports.

FORMALDEHYDE, 40%.—Remains steady at about £36 10s. per ton, ex works.

GLAUBER SALTS.—English material quoted £4 10s. per ton, ex station. Continental on offer at about £3 5s. per ton, ex wharf.

LEAD, RED.—Price now £37 10s. per ton, delivered buyers' works.

LEAD, WHITE.—Quoted £37 10s. per ton, c.i.f. U.K. ports.

LEAD ACETATE.—White crystals quoted round about £39 to £40 per ton, ex wharf. Brown on offer at about £2 per ton less.

MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store. In moderate demand.

METHYLATED SPIRIT.—Industrial quality 64 O.P. quoted 1s. 4d. per gallon, less 2½%, delivered.

POTASSIUM BICHROMATE.—Quoted 4⅜d. per lb. delivered U.K. or c.i.f. Irish ports, with an allowance of 2½% for minimum 2½ tons to be taken.

POTASSIUM CARBONATE.—Spot material on offer at £26 10s. per ton ex store. Offered from the Continent at £25 5s. per ton c.i.f. U.K. ports.

POTASSIUM CHLORATE, 99¾/100% POWDER.—Quoted £25 10s. per ton ex wharf. Crystals 30s. per ton extra.

POTASSIUM NITRATE.—Refined granulated quality quoted £19 2s. 6d. per ton c.i.f. U.K. ports. Spot material on offer at about £20 10s. per ton, ex store.

POTASSIUM PERMANGANATE B.P. CRYSTALS.—Quoted 5¼d. per lb., ex wharf.

POTASSIUM PRUSSIATE (YELLOW).—Spot material quoted 7d. per lb., ex store. Offered for prompt delivery from the Continent at about 6¾d. per lb. ex wharf.

SODA, CAUSTIC.—Powdered 98/99% £17 10s. per ton in drums, £18 15s. per ton in casks. Solid 76/77% £14 10s. per ton in drums, and £14 12s. 6d. per ton for 70/75% in drums, all carriage paid buyers' stations, minimum 4-ton lots, for contracts 10s. per ton less.

SODIUM BICARBONATE.—Refined recrystallised £10 10s. per ton, ex quay or station. M.W. quality 30s. per ton less.

SODIUM BICHROMATE.—Quoted 3⅝d. per lb. delivered buyers' premises with concession for contracts.

SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station. Powdered or Pea quality 27s. 6d. per ton extra. Light soda ash £7 1s. 3d. per ton ex quay, minimum 4-ton lots with various reductions for contracts.

SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £8 17s. 6d. per ton, ex station, minimum 4-ton lots. Pea crystals on offer at £14 15s. per ton, ex station, minimum 4-ton lots. Prices for this year unchanged.

SODIUM NITRATE.—Chilean producers are now offering at £9 9s. per ton, carriage paid buyers' sidings, minimum 6-ton lots, but demand in the meantime is small.

SODIUM PRUSSIATE.—Quoted 5¼d. per lb., ex store. On offer at 5d. per lb., ex wharf, to come forward.

SODIUM SULPHATE (SALTCAKE).—Prices 50s. per ton, ex works, 52s. 6d. per ton, delivered for unground quality. Ground quality 2s. 6d. per ton extra.

SODIUM SULPHIDE.—Prices for home consumption. Solid 60/62% £9 per ton. Broken 60/62% £10 per ton. Crystals 30/32% £7 2s. 6d. per ton delivered buyers' works on contract, minimum 4-ton lots. Special prices for some consumers. Spot material 5s. per ton extra.

SULPHUR.—Flowers, £12 per ton; roll, £10 10s. per ton: rock, £10 7s. 6d. per ton; ground American, £9 5s. per ton; ex store.

ZINC CHLORIDE, 98%.—British material now offered at round about £20 per ton, f.o.b. U.K. ports.

ZINC SULPHATE.—Quoted £10 per ton, ex wharf.

NOTE.—Please note that the above prices are for bulk business and are not to be taken as applicable to small parcels.

How Not to Apply for Vacant Posts

THE following extract from a letter from a technical director is published in the *Chemical Practitioner*: "I take this opportunity of saying that I think applications are presented poorly generally. If from an application I judge a man to be a 'possible' I have no hesitation in asking the firm to bear the cost of travelling expenses for an interview. I am reluctant to make the same request simply to find out details which should have been included in the application, and perhaps then to find that the applicant is impossible. I know that you do issue advice on the matter of applications. It evidently is not always taken. I have noticed that the men who turn out well are those who have sent in business-like applications. Those who prove not entirely satisfactory are those who have been engaged in spite of a poor application. Hence, I tend to neglect entirely the poor applications. You may argue that the position offered may not attract good men and good applications. It is quite possible, though, that a fairly good man does not get an interview because of a poor first impression. Ideas about the ideal application doubtless vary. Personally, I like to receive a short covering letter and fairly full details of training and experience tabulated and in concise language."

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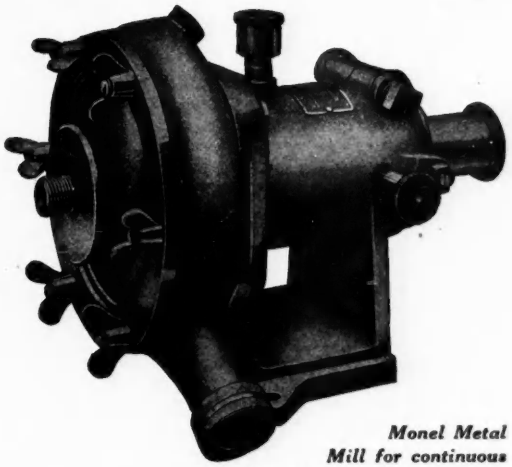

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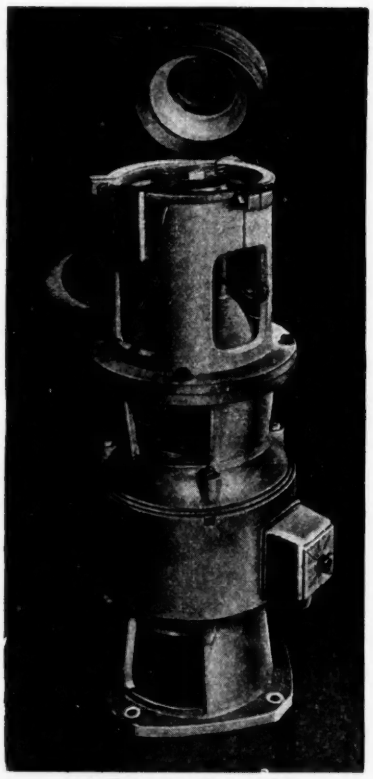

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Manchester Chemical Market

[From Our Own Correspondent.]

Manchester, November 28, 1929.

Deliveries of heavy chemical products against contracts are still being called for in fairly satisfactory quantities, with a moderate spot business being put through. In certain lines, contract quotations for delivery over the coming twelve months have now been decided, and in these sections a fair volume of forward bookings has been reported. Taking the market generally, prices are firm pretty well all round, and only rarely is there anything resembling weakness in evidence.

Heavy Chemicals

With regard to sulphide of sodium, a moderate trade is being done, and now that 1930 prices have been fixed some interest is being shown in forward positions. For the 60-65 per cent. concentrated material prices range from £10 to £11 per ton, according to quantity, for the solid, £11 to £12 per ton for the broken, and £12 15s. to £14 for the flake, with odd lots at 15s. per ton additional; the crystallised quality is on offer at from £8 2s. 6d. to £9 2s. 6d. per ton, plus 2s. 6d. per ton extra in the case of odd parcels. These parcels represent substantial advances compared with those ruling for the current year. With regard to bichromate of soda, there is a fair movement in this section on a contract basis of 3⅝d. per lb. Caustic soda meets with a quietly steady demand and offers are firm at from £12 15s. to £14 per ton, according to quality and in contracts; for next year's deliveries makers have decided to maintain rates at current levels. There has been only a quiet trade passing this week in the case of chlorate of soda, quotations for which are at up to 2¾d. per lb. Phosphate of soda is steady at about £11 per ton for the dibasic quality, although there has not been much in the way of business during the past week. Bicarbonate of soda is firm and in fair request at £10 10s. per ton. Prussiate of soda meets with a fair amount of inquiry at a firm range of prices, these running from 4¾d. to 5¼d. per lb., according to quality. A steady business is going through in the case of alkali, which is quoted on a contract basis of £6 per ton. Only a moderate demand for salt-cake has been reported here during the past week, with current values at from £2 17s. 6d. to £3 per ton. Hyposulphite of soda is on the quiet side, with the photographic quality quoted at about £15 per ton, and the commercial material at from £9 to £9 5s.

There is a steady inquiry about for yellow prussiate of potash, offers of which are maintained at from 6¾d. to 7¼d. per lb., according to quality. Permanganate of potash is not very active but prices keep up at about 5½d. per lb. for the B.P. material and 5¼d. for the commercial. A quietly steady demand is reported for carbonate of potash, which is firm at round £26 per ton, and also in caustic, which is quoted at from £32 to £33 10s. per ton. Chlorate of potash is on the quiet side, with current values at round 2⅞d. per lb. There is a fair inquiry about for bichromate of potash on a contract basis of 4⅜d. per lb.

With regard to sulphate of copper, buying interest in this section is on moderate lines, with prices fairly steady at from £26 10s. to £27 per ton, f.o.b. Arsenic is not attracting very much attention but values are maintained at about £16 per ton at the mines, for white powdered, Cornish makes. Nitrate of lead is slow and easy in tendency at down to £33 per ton, with the acetates also relatively quiet at about £39 and £40 per ton, respectively, for the brown and white qualities. There has been little change in the position of the acetates of lime, the brown material being quoted at £7 15s. per ton and the grey at £16.

Acids and Tar Products

Tartaric acid keeps fairly steady, although the demand in this section is not particularly active; current offers are at 1s. 4¼d. to 1s. 4½d. per lb. Citric acid is on the quiet side, and down to 2s. per lb. is now being quoted. Oxalic acid keeps steady and is in fair request at about £1 13s. per cwt., ex store. With regard to acetic acid, this is firm, and in quietly steady demand at £66 per ton for the glacial and £36 for the 80 per cent. commercial.

Pitch is unchanged in price at round 47s. 6d. per ton, f.o.b., with the demand on moderate lines. Creosote oil is on offer at about 4⅜d. per gallon naked, a quiet business begin reported. Solvent naphtha, at down to 1s. 2d. per gallon, is not too strong, and business is slow. Carbolic acid keeps firm at from 2s. 6d. to 2s. 7d. per gallon for crude and about 9¾d. per lb. for crystals.

Company News

Lawes' Chemical Manure.—A loss of £4,749 is reported for the year ended June 30 last.

International Nickel Co. of Canada.—The directors have declared a dividend of 25 cents per share on the common stock, less tax at 4s., payable on December 31.

Metals Coating Co., Ltd.—It is announced that permission to deal in Metals Coating shares has been granted by the Stock Exchange, and the shares are now quoted.

Lydenburg Platinum Areas.—A profit of £37,710 is announced for the year ended June 30 last. A dividend of 3d. per share has been declared and £19,460 is carried forward. Also an interim dividend of 3d. per share, less tax, is announced on account of the year 1929–30.

Broken Hill South.—The net profits to June 30 were £358,259 (against £208,362). Dividends absorbed £180,000, debenture sinking fund took £13,333, appropriation for plant and development £120,000, leaving, including £121,529 brought in and £65,660 not expended on plant and development last year, £232,116. Assets, exclusive of mine and plant, and of shares in other companies, latter costing £437,970, show surplus over liabilities of £945,846.

Anglo-Persian Oil Co.—An interim of 5 per cent., less income tax, on the ordinary shares has been declared in respect of the year ending December 31, 1929, payable on December 21. In respect of holdings in Anglo-Persian the British Government receives £375,000 from the above dividend, the Burmah Oil Co. £143,099 and the B.O.C. Anglo Persian Share Trust £35,000. This is the first interim distribution by the company since 1926–27, and its advent was forecast by Sir John Cadman, the chairman, in his speech at the general meeting in June last.

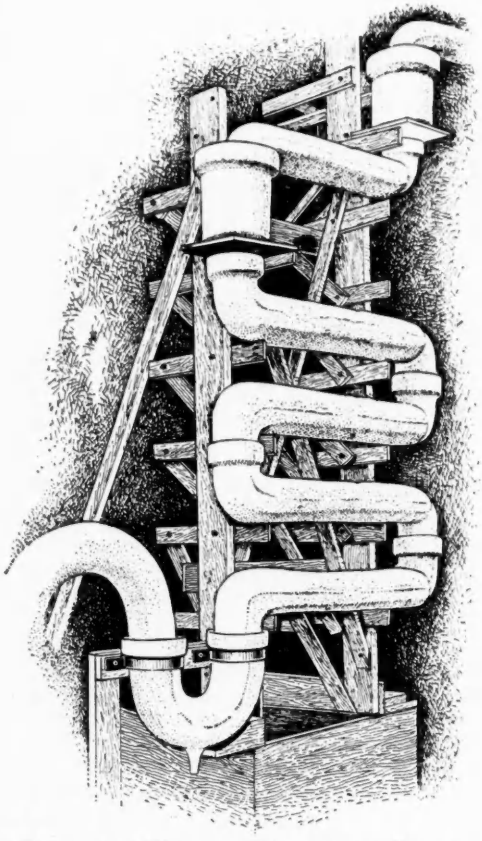
British Cotton and Wool Dyers' Association.—The interim report for the half-year to September 30, 1929, shows net profits of £37,160, compared with £42,474 for the corresponding six months of 1928. The present figures are arrived at after charging £2,135 for specific depreciation (against £2,516 a year ago), £28,017 (against £27,612) for repairs, renewals and other contingencies, and transferring £12,500 (same) to depreciation fund, raising the total to £69,956. Including £30,057 brought in from March 31 last, the total credit balance at September 30 was £67,217, against £63,901 at September 30, 1928, when only £21,427 was brought in.

Tate and Lyle, Ltd.—After providing for the accrued liability to taxation, and for the remuneration of the managing directors, and again placing £150,000 to general reserve, £50,000 to depreciation reserve, and £100,000, against £60,000, to investment reserve, the net profit is £586,582 for the year's working to September 30, 1929, against £464,852 last year. Adding the brought forward of £41,135, there is an available balance of £627,717. The preference dividend absorbs £71,500, and the interim dividend of 4 per cent. on the ordinary £132,480. The directors recommend a final dividend of 11 per cent., making 15 per cent. on the year on the ordinary, requiring a further £364,320, against 12 per cent. last year, carrying forward £59,417.

Continuation of Franco-German Caustic Potash Cartel

The Elektro-Chemische Produkte G.m.b.H., of Frankfurt-on-the-Main, the international cartel of German and French caustic potash producers, proposes to renew its cartel contract, which now extends to the end of 1929, without changing its terms. This cartel involves the larger French and German producers of caustic potash, potash liquors, and potassium carbonate. The producers buy their raw material (potassium chloride) through the respective potash syndicates of the two countries for processing electrolytically. German members of this sales combine include: I.G. Farbenindustrie A.-G., Frankfurt-on-the-Main (Griesheim-Elektron); Kali-Chemi A.G., Berlin (Neustassfurt-Friedrichshall); Chemische Fabrik Lückau, Ammendorf/Halle; and Consolidierte Alkaliwerke Westeregeln (Egeln, Bezirk Magdeburg).

The "VITREOSIL"



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How to Run a Chemists' Club

The New York Touch

AFTER all it's *your Club*. Why not come around once in a while for lunch, to be followed by a business conference in the comfortable chairs of the Lounge, by a talk-fest with your old cronies, some of whom you are sure to meet, or by a game of pool or billiards ?

Then on Saturday afternoon, there usually is a game of bridge and one of chess going on, it is pretty easy to start a second one, or a third.

The Club is nice and quiet these days, all stridulation and other unseemly noises of pneumatic drills, riveters, and other disturbers of the peace at and on the new buildings in our immediate neighbourhood having ceased.

Without casting aspersions, brick-bats, H_2S eggs, or vituperations (nice $6 word that) at previous House Committees, THE PERCOLATOR thinks that we now have a real, live Committee on the job *all the time*.

In spite of the obvious handicaps of our building, the opposition of a few (*Populists*, shall we call them ?), who think anything is good enough for a chemist, our House Committee is doing wonders with the limited means at its disposal.

There is now available, a dressing-room equipped with all the necessary conveniences, for the general use of all Club members. It also contains a number of capacious lockers for those who keep " glad rags," or an extra suit, in town. All the lockers in Room 410 have been rented, but if enough applications are received, another locker-room will be equipped.

A fine lot of new plates, and other dining-room ware, all marked with the Club emblem in colours, has been ordered and is expected shortly.

A real, honest-to-goodness valet service has been installed in the tower room to the left of the Billiard Room. Here suits will be pressed promptly, dry cleaning attended to, and buttons will be sewn on to meet the emergency. It is also expected that a stock of collars, collar-buttons, and the like will be kept in stock for the needy.

Other improvements are under way, but we shall let them crystallise a little more before reporting on them.—From *The Percolator*, the journal of the New York Chemists' Club.

Vapour Pressures of Oxides

Extensive Investigation Planned

DESPITE the metallurgical interest inherent in various processes involving the volatility of metallic oxides, few actual measurements of the vapour pressures of such materials have been made. Thus the " Wälz " process, which has recently commanded such wide interest in Germany and Poland for the concentration of the lower grade zinc ores into a more or less impure zinc oxide material, involves the volatility of the oxides of lead, zinc and cadmium. Other processes of past or present interest are the "converting " of scrap brass and bronze, the converting of lead-copper mattes, and the " dezincing " of slags. In the softening of lead, the volatility of the metals and oxides of the fifth group of the periodic classification, arsenic and antimony especially, are of direct interest.

An important reason why actual vapour pressure determinations have not been made on most of these oxides may have been the difficulty of finding suitable non-slagging materials for the construction of containers in laboratory apparatus for vapour pressure determinations. Recent experiments at the Pacific Experiment Station, Berkeley, Calif., in co-operation with the University of California, have shown that, within limits, it is possible to use silica containers. Thus, in preliminary tests, it was found that silica glass will withstand the action of antimony trioxide up to nearly 800° C., at which temperature the oxide has an approximate vapour pressure of 35 millimetres. Above this temperature slagging occurs. For determinations up to this temperature, a new form of " tensimeter " has been devised, in which the vapour pressures of the materials will be weighed directly with a balance. This device will have a sensitivity of about 0·005 mm. pressure, with a range up to 50 or 60 mm., and will thus cover the metallurgically important range of vapour pressures of such oxides as antimony, arsenic, bismuth, lead and cadmium. It is planned to determine these materials first, and later to attempt the extension of the measurements to zinc oxide, cuprous oxide, and others of possible metallurgical importance.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides and every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

RAPIDOL, LTD., London, W., manufacturers of hair dyes, etc. (M., 30/11/29.) Registered November 13, £30,000 debentures ; general charge. *——. May 14, 1929.

Satisfaction

PONTITHEL CHEMICAL CO., LTD., Kenchester. (M.S., 30/11/29.) Satisfaction registered November 11, all moneys, etc., registered May 18, 1916.

New Companies Registered

W. S. PINCHIN, LTD., Wellington Works, Albert Lane, Ipswich. Registered November 21. Nominal capital, £1,000 in £1 shares. Colour, paint and varnish manufacturers, etc. A subscriber : W. S. Pinchin, 325, Norwich Road, Ipswich.

PITCH MARKETING CO., LTD., Coronation House, 4, Lloyds Avenue, London, E.C.3. Registered as a " private " company on November 23. Nominal capital, £100 in 10s. shares. To buy, sell, export, import and deal in any kind of pitch obtained from coal ; to charter vessels, enter in freight contracts and effect insurances, etc.

Conference on International Fairs and Exhibitions

AT the beginning of December a Diplomatic Conference is to take place in Paris on the subject of International Fairs and Exhibitions, and the British Government have invited Mr. Guy Locock, deputy director of the F.B.I., to be a member of the delegation. Besides his connection with the F.B.I., Mr. Locock is Rapporteur of the Committee on Exhibitions of the International Chamber of Commerce. At the end of last year a Diplomatic Conference in Paris drew up a Convention for the purpose of regulating official international exhibitions (*i.e.*, those either controlled or officially approved by Governments), incorporated in which convention was a provision for the establishment of an international bureau to carry out its terms. The composition and powers of this bureau will be one of the chief subjects for discussion at the Conference in December. Another subject which will be dealt with will be an examination of the question as to whether it is possible and desirable to provide for Government regulation of international fairs and international trade exhibitions organised by individual industries. The view of the Federation of British Industries, which is supported by the International Chamber of Commerce, is strongly opposed to Government interference with international fairs of this nature, which they consider are a matter for decision solely by the industries interested. It is believed that a considerable measure of support for the point of view of the F.B.I. can be counted upon in foreign industrial and commercial circles.

Fertilisers for the Sugar Industry

EXCLUSIVE of molasses and manure, the use of the principal fertilisers by the sugar industry in Java advanced 7 per cent., increasing from 97,300 tons in 1927 to 104,100 tons, in 1928, ammonium sulphate and double superphosphates being in greatest demand. The following figures show the quantities of the principal fertilisers consumed during 1928 :—Ammonium sulphate, 97,200 tons ; superphosphate, 100 tons ; double superphosphate, 5,300 tons ; kapok seed cake, 1,500 tons ; total, 104,100 tons. Other kinds of fertilisers used by the sugar industry included filter refuse, boiler ashes, bone meal, and bat manure.